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ON THE VALUE OF ROENTGEN-RAY EXAMINATIONS IN THE DIAGNOSIS OF CANCER OF THE STOMACH.

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AND

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It is a well-known fact that the diagnosis of cancer of the stomach is often exceedingly difficult, and especially is this true in regard to the early recognition of this affection. Even although the morbid process may have assumed considerable proportions, many of the important manifestations may still be absent, so that even at a relatively advanced stage a correct diagnosis, based upon the symptomatology, is often impossible. Any new method, therefore, which promises substantial aid in solving this intricate problem must be regarded as a very welcome addition to the means we already possess.

The X-ray has presented us with an additional method of diagnosis in the study of gastric cancer, and although like other methods of medical diagnosis which are not absolute, it is probably more correct than any of the other means for diagnosis which are common at the present day. Its findings, however, should always be taken in conjunction with the clinical findings before the final diagnosis is made.

In the X-ray study of cancer of the stomach, it is important, first of all, to recognize the varying positions and functions of the stomach under normal conditions.

The fundamental difficulty lies in the fact that the stomach is not a hard and fixed body; for we know that a perfectly normal stomach may present great variability, not only as to position, but also as to motility and the expulsion of its contents. As a matter of classification we may divide the various types of stomach into three classes—first, the stomach of the fleshy individual; second, the stomach of the medium-weight individual; and third, the stomach of the thin individual.

The three classes of stomachs differ very materially as to shape and position.

In the first group we are dealing with a high stomach, the pylorus lying to the right of the median line, well up under the gall-bladder region, and occupying an almost horizontal position. In the second group we have the stomach of the medium-

weight individual, which is generally cow-horn in shape, the pylorus resting in the median line, or just to the right of the spine. In the third group, we are concerned with the stomach of the thin individual, which lies to the left of the median line, and is generally prolapsed and fish-hook in shape, with the fundus well down in the pelvis. Associated with these various conditions, we have corresponding differences in the motility of the stomach.

It can easily be seen that, in the first two types, not only the motility, but also gravity aids in emptying the stomach, whereas in the third class we have gravity acting against its normal motility, inasmuch as the pylorus and duodenum are always from two to three inches above the fundus of the stomach.

We have no hard and fast rule, therefore, according to which we can say that the stomach must empty itself in a certain number of hours, and that, if this time be prolonged, we are justified in concluding that we are dealing with some pathological condition.

In the first class the stomach empties itself in about three hours; in the third class it takes about six hours. Hence the question of any beginning obstructive lesion is dependent very largely on the character of the stomach with which we are dealing. Another difficulty to be encountered lies in the fact that the motility of a normal stomach may be affected by conditions outside of the organ itself.

Consequently, in dealing with carcinoma of the stomach we cannot rely on the size, shape and position of the stomach or upon the retention of its contents. Our determination of the special lesion is dependent upon the study of two conditions, namely, the peristaltic waves of the stomach, and the many irregularities, or filling defects, in the organ itself. Unfortunately, as we have already noted, we possess no normal type of stomach from which we can draw comparisons; consequently, we are forced to determine the type of stomach that is normal for the individual undergoing the examination.

It is a well-known fact that the motility of the stomach is more or less affected by lesions in the organ itself, the degree to which it is affected varying according to the location of the lesion.

As a matter of classification, we may divide the carcinomatous lesions of the stomach into three classes; first, lesions in the cardiac end of the stomach; second, lesions in the body of the stomach not affecting the orifices; third, lesions at the pyloric end of the stomach. In each of these conditions the activity of the stomach is materially affected, but in quite a different manner.

In lesions of the cardiac area of the stomach, the cardiac orifice is almost always affected, and the patient comes for an examination because there is difficulty in deglutition. An examination reveals a stricture of the cardiac orifice together with a small or large filling defect in the immediate vicinity. The activity of the stomach itself is normal and, unless the lesion is very extensive, there is no interruption in the peristaltic waves.

In lesions in the body of the stomach, one may have an extensive growth, and yet the patient may complain of very few symptoms, inasmuch as the motor activity is not interfered with. As this lesion rarely affects the cardiac or the pyloric orifice, obstructive symptoms are absent, the stomach emptying at the normal rate or perhaps a little more rapidly than normally. The roentgen-ray examination of the stomach of this form generally shows that the peristaltic waves are interrupted in their course at the seat of the lesion, inasmuch as the lesion itself is hard and indurated, and does not admit of further peristaltic movements. In addition a persistent filling defect is almost always present. This filling defect is produced by the growth in the stomach wall bulging generally more or less into the lumen of the organ itself, so that it is outlined by the bismuth in the stomach proper and presents the appearance of an indentation. In the third class of cases, that is, in lesions about the pylorus, the symptoms arise early as a rule and are due to a partial obstruction which quickly attracts the patient's attention to the gastric disorder.

From a roentgenological point of view we classify growths at the pylorus into two forms.

The first, the annular carcinoma, has its origin within the pylorus itself, and, although it may be very small in size, produces symptoms relatively early, as it soon causes a greater or less degree of obstruction.

The second type also has its origin at the pylorus; it is not annular in form, but invasive, most frequently extending along the wall of the stomach, especially at the pylorus. Such a growth may, or may not, produce early obstruction.

The annular type of carcinoma is easily recognized, inasmuch as the stomach is observed to be perfectly normal except at the pyloric end. The pylorus, instead of being clear-cut and sharp, is generally somewhat thickened and slightly depressed in the center, so that the structure assumes the shape of a crater.

The second type of carcinoma may exist for some time without being recognized, because in the absence of any symptoms of obstruction the patient, being still in a comfortable state, does not present himself for an examination. In this type of growth one finds a persistent filling defect in or close to the pylorus, and ascending away from it. The mass is indurated and free from peristaltic waves, since the waves pass over the area and are lost.

In cases of partial obstruction the stomach begins to show a very definite change. In the early stages we find active contractions of the organ with a slow elimination of its contents. Another very significant sign is that a portion of the stomach just within the pylorus and on the greater curvature in the pyloric region shows a tendency to bulge. The cause of this condition is as follows: The active contractions of the stomach force all of the food toward the pyloric region; the pylorus not being patent, as a result of this constant pressure the prepyloric region becomes dilated, so that the plate presents the pylorus, apparently not at the end of the stomach, but with the prepyloric region extending further to the right than the pylorus, the latter resting on the top of the stomach, and pointing to the splenic region. This prepyloric bulging is dependent

largely upon the duration of the affection. In the early stages it is very small, but, as the condition advances, it may reach the size of a hen's egg. As the condition advances still further, dilatation begins to take place, and after a time practically the entire fundus yields, so that a typical saccular formation is produced and all the bismuth rests in the fundus. When the stomach is in this condition, an X-ray examination will show a retention of contents for from 10 to 20 hours.

Unless due care be exercised, one may easily be misled by certain reflex or spastic conditions of the stomach. It is not uncommon to observe a stomach presenting a persistent filling defect in a definite area continuing over a period of an hour or two, and in a single instance under our observation for 48 hours, due to this condition. In doubtful cases the question of spasm of the stomach can easily be eliminated by the administration of full doses of atropin for one or two days, until the patient is well under its influence. A second examination, made under these conditions, will immediately show that the suspicious area has completely vanished, and that the condition previously observed was due to spasm.

In the X-ray study of gastric carcinoma the differential diagnosis between this condition and ulcer is often very difficult. It is still a much debated question as to whether carcinoma of the stomach has its origin primarily as such, or is the result of a transition from an old ulcer. If the latter view be correct, one can readily understand the difficulty in determining when the benign condition begins the transition into malignancy. The situation of both carcinoma and ulcer is very frequently the same, although we observe carcinoma more frequently on the greater curvature than ulcer.

In the differential diagnosis between the two conditions the points to be taken into consideration are as follows:

1. *Peristalsis.*—In carcinoma, unless there is obstruction, there is always hypermotility with rapid evacuation of contents. In ulcer there is always hypermotility, with a spasm of the pylorus and more or less retention of contents.

2. *Position.*—Carcinoma may occur in any part of the stomach. The invasive lesions are more frequently seen on the lesser curvature near the pylorus, and less frequently on the greater curvature. The massive growths are more generally seen on the greater curvature, whereas ulcer is generally observed on the lesser curvature near the pylorus, although it may occur on the greater curvature.

3. *Filling Defect.*—In carcinoma the filling defect is generally surrounded by an invasive area, which, while not appearing on the plate, interferes with motility, producing an apparently large dead area. In ulcer the filling defect is much smaller, and is not so apt to have the immediate peristaltic waves interfered with, although, if the inflammatory area be large, there may be also a dead area surrounding the filling defect.

Carcinoma of the pylorus in the earliest stage is generally annular and produces a crater-like appearance. In ulcer of the pylorus there is a filling defect, but it does not generally assume the crater-like appearance.

When any of these conditions pass on to the obstructive stage, the change that is caused by the dilatation may mask the signs associated with the filling defect.

In our experience, in the very early stages of gastric cancer, it is frequently impossible to determine whether we are dealing with a malignant or a simple ulceration. Our main aim, however, is to decide whether the lesion at hand is really an ulcer, or not. Inasmuch as indurated gastric ulcers have at times a tendency to become malignant and produce roentgenograms similar to those which are cancerous, they must be included in the same class. The exact diagnosis must be cleared up by further investigation into the clinical history and the examination. But even under these conditions there are many instances in which the diagnosis may still remain in doubt until operation, and microscopic examination of the specimen after removal, finally establish the true nature of the disease.

In the later stages of gastric cancer, however, when the growth is large, it is usually a very simple matter to arrive at a correct conclusion regarding its malignancy, but at this stage the symptoms are usually so well established that it is hardly necessary to seek further evidence by means of roentgen-ray examinations.

The X-ray, however, even at this stage, furnishes us important evidence as to whether the tumor is or is not operable, inasmuch as it clearly establishes the location and extent of the growth, together with the degree of obstruction. Hence, in many instances, it will indicate the usefulness or uselessness of surgical procedures.

Since we have taken up the positive phase of gastric cancer, it is well to draw some conclusion regarding the negative findings. If the fact can be established that there is an absence of all morphological defects in the wall of the stomach; that the peristalsis of this organ is normal, and that there is no tendency to even a partial obstruction, carcinoma of the stomach can usually be ruled out. This is an exceedingly important procedure, as a negative finding is of quite as much importance as a positive one.

In our roentgen-ray study of gastric cancer we have selected 50 consecutive cases, including those only concerning which we could feel confident of the correctness of the diagnosis. Of these, the growth was located in 34 instances about the pylorus; in nine it involved the body of the stomach without interfering with the orifices, and in seven the cardia was involved. It is interesting to note the relative incidence of the other signs of the disease in these special cases at the time when the X-ray examinations were made.

Of the 50 cases, the gastric secretion was obtained in 46. There was a normal acidity in four instances; a hypochlorhydria or an absence of acid in 36 instances, and a hyperchlorhydria in six instances.

In the 36 cases showing a hypochlorhydria, lactic acid was present in 28 instances, and the Oppler Boas bacillus in 24. Occult blood was present in the stools in 42 of all the cases.

A palpable tumor was observed in 34; dysphagia in seven; pain was present in 49; vomiting in 44; gastric hemorrhage

in 14; melena in eight; occult blood in 46; dilatation of the stomach in 24 cases.

Of these cases the X-ray gave positive evidence of disease in 46 instances, of which four were early cases and 42 were late cases. In two of the four early cases the roentgenogram gave a positive diagnosis of carcinoma. In the other two, however, an ulcerative lesion was found which was thought to be benign. The X-ray evidence, then, was positive in 42 of the late cases. It was positive, as far as the lesion was concerned, in all of the cases, but positive in only 95 per cent of the cases as regards the actual diagnosis of carcinoma. In the early cases the X-ray showed a lesion in all; in two of them, however, it was thought to be benign, but exploration proved the condition malignant.

This method of examination, according to our experience, possesses about the same diagnostic value as any of the other early signs of this disease, when taken alone, but in conjunction with the clinical evidence a positive diagnosis can almost always be made.

Inasmuch as the X-ray clearly reveals the evidence of an indurated ulcer in most instances, and in view of the fact that indurated ulcers are at times the beginning of cancerous growths, it affords a means of establishing early the diagnosis of gastric cancer.

From our studies of the many cases of cancer of the stomach, in which X-ray examinations have been made, we believe that we are justified in drawing the following conclusions.

1. The roentgen-ray offers most valuable assistance as an aid in the diagnosis of gastric carcinoma; and this is especially true when the lesion is situated in the so-called silent area. It should not be relied upon alone in the diagnosis of early cases without a strict consideration of the clinical aspect of the disease, but, when taken in conjunction with the other signs, it is of the greatest diagnostic value.

2. Indurated gastric ulcers give roentgenograms similar to those of carcinoma; but inasmuch as ulcers are frequently precursors of cancer, they may be grouped for practical purposes in the same class. It is often possible to determine their true nature only by microscopic examination of the excised area.

3. In the diagnosis of carcinoma of the stomach two conditions must be taken into consideration; first, the peristaltic waves of the stomach; and second, the morphological defect in the stomach.

4. In carcinoma of the cardiac area of the stomach there is usually a filling defect present, the activity of the stomach itself being normal, and, unless the lesion be very extensive, there is no interruption in the peristaltic waves. In lesions of the body of the stomach, the peristaltic waves are interrupted in their course at the seat of the lesion, because the lesion itself is hard and indurated, and does not admit of further peristaltic movements. There is also present a persistent filling defect. In pyloric carcinoma there are usually signs of early obstruction in addition to a filling defect of small or large size, according to the extent of the growth.

5. In carcinoma, unless there be obstruction, there is always hypermotility with rapid evacuation of contents. In ulcer there is hypermotility with pylorospasm, and more or less retention of contents. In carcinoma the filling defect is generally surrounded by an invasive area, interfering with the motility, and producing a large dead area, whereas in ulcer the filling defect is much smaller, and is not so apt to interfere with the immediate peristaltic waves.

6. The roentgen-ray furnishes us with important evidence regarding the operability or non-operability of the growth, pointing out, as it does, the location and extent of the growth, together with the degree of obstruction and the amount of involvement.

7. Negative findings are at times quite as important as positive ones, inasmuch as absence of the various X-ray signs of cancer affords presumptive evidence of the absence of this affection.

A REPORT OF SEVENTY CASES OF BRAIN TUMOR.*

By George J. Heuer and Walter E. Dandy.

(From the Surgical Service of The Johns Hopkins Hospital.)

It is but necessary to review the surgical literature of the past two years[1] to appreciate not only the advance that has been made in the localization and treatment of intracranial new growths, but also the number of problems in this field that require elucidation. Many of these are still fundamental problems. The necessity of early diagnosis and early operative treatment, though often urged, requires further emphasis; for 10 per cent of the patients that come into surgical hands are blind on admission. The average mortality in the practice of those most interested in the surgery of brain tumors is over 30 per cent (excluding Cushing's 8 to 10 per cent), apparently to a large extent because the question of the control of hemorrhage has not been altogether solved. Infection, especially in the nasal approach to hypophyseal tumors, has been a factor of importance in operative results (a recent report recording 14 deaths from meningitis); and in view of this danger it would seem wise to substitute, when possible, an aseptic approach to the chiasmal region for the present popular nasal route. Whether or not the removal of the infiltrating type of glioma should be attempted, what is the site of election for decompressive defects, whether one-stage or two-stage operations should be employed, even the choice and method of anesthesia, are questions more or less settled no doubt in the minds of

* The study of these cases was begun over a year ago, but the publication of the report was delayed. It was thought best to publish the report as it stands rather than include the total number of cases which have come under observation to the present time—a total of over 100.

TABLE I.—CEREBRAL AND BRAIN-STEM TUMORS CERTIFIED BY OPERATION OR AUTOPSY.

	Surg. No.	Type of tumor.	Location of tumor.	Operation.	Lesion verified at	Result.
1	31937	Tuberculoma	Subcortical, Pre-Rolandic	Enucleation	Operation	Improved.
2	32813	Cystic glioma	Subcortical, Pre-Rolandic	Enucleation, total (?)	Operation	Well.
3	33767	Cystic glioma	Subcortical, Int. Capsule	Enucleation	Operation	Improved.
4	33206	Cyst, recurrent	Subcortical, Pre-Rolandic	Enucleation	Operation	Unimproved.*
5	32307 32913	Glioma	Optic thalamus, right	Subtemporal decompression	Autopsy	Returned to work for five months. Died suddenly.
6	32368 33372	Glioma	Diffuse, paracentral region	1. Subtemporal decompression. 2. Partial removal.	Operation	Improved.*
7	30873	Glioma	Third ventricle	Cerebellar exploration	Autopsy	Dead three days after operation.
8	31135	Glioma	Third ventricle	Sellar decompression	Operation	Unimproved.*
9	31801	Tuberculoma	Midbrain (solitary)	None	Autopsy	Dead.
10	34145	Cystic glioma	Temporal lobe	None	Previous Operation.	Improved.
11	34023	Pachymeningitis interna hemorrhagica.	Right hemisphere	Exploratory craniotomy. Removal of membrane.	Operation	Improved.
12	34404	Glioma	Left frontal lobe	Exploration and decompression.	Operation	Unimproved.
13	34645 35033	Glioma	Left temporal lobe	1. Decompression. 2. Exploratory craniotomy.	Operation	Improved.
14	32720 35005	Glioma	Right temporal lobe	1. Decompression. 2. Partial removal of tumor.	Operation	Improved.
15	30903	Glioma, calcified	Right hemisphere	None	X-ray	Not treated.
16	34515	Cyst	Hypophysis	Craniotomy. Evacuation of cyst.	Operation	Well.
17	35166	Glioma (?). Healed abscess (?).	Right temporal lobe	Exploratory craniotomy	Operation	Improved.
18	34653	Cyst	Third ventricle	Craniotomy. Evacuation	Operation	Well.
19	33974	Encephalitis	Right hemisphere	Excision of mass	Operation	Well.
20	35586½	Glioma	Left temporal lobe	Exploration and decompression.	Operation	Improved.
21	31628 32976	Aneurism of internal carotid, bilateral.	Temporal fossae	1. Decompression. 2. Repair of hernia cerebri.	Autopsy	Returned to work for 16 months. Then sudden death.
22	34398	Glioma	Left temporal region	Exploration. Excision of tumor.	Operation	Well.
23	34722	Glioma	Left frontal lobe	Exploration and decompression.	Autopsy	Dead.
24	35534	Endothelioma	Left frontal lobe	Enucleation (3 stages)	Operation	Improved.
25	35658	Glioma	Right frontal lobe	Exploratory craniotomy. Extirpation.	Operation	Improved.
26	36118	Cyst (arachnoidal)	Right temporal lobe	Craniotomy. Evacuation of cyst.	Operation	Well.
27	35746	Glioma (?). Neuroma (?)	Right paracentral region	Craniotomy. Excision of tumor.	Operation	Well.
28	35580	Cyst (arachnoidal)	Right temporal lobe	Exploration. Evacuation of cyst.	Operation	Improved.
29	34026	Glioma	Third ventricle	1. Decompression. 2. Exploratory craniotomy.	Operation	Unimproved.
30	25006 36746	Endotheliomata, recurrent (?).	Right parietal region	Craniotomy. Enucleation	Operation	Well.

* The patient has since died.

SUMMARY OF TABLE I.

Number of cases operated upon.	Number of operations.	Operative mortality.	Case mortality.	Apparently well on discharge.	Improved.	Unimproved.
27	32*	6.2%	7.4%	8	13	4

* Surg. No. 35534, in which three stages were necessary for the removal of the tumor, is counted as one operation.

TABLE II.—CEREBELLAR AND CEREBELLOPONTINE TUMORS CERTIFIED BY OPERATION OR AUTOPSY.

	Surg. No.	Type of tumor.	Location of tumor.	Operation.	Lesion verified at	Result.
1	33874	Cyst	Intracerebellar	Suboccipital exploration. Evacuation.	Operation	Well.
2	32311	Endothelioma	Cerebellopontine angle	Enucleation	Operation	Dead five days after operation.
3	31325	Glioma	Cerebellum and pons	Exploration	Autopsy	Dead three hours after operation.
4	30801	Cyst	Intracerebellar	Evacuation	Operation	Well.
5	30724	Cyst	Intracerebellar	Evacuation	Operation	Well.
6	30854	Glioma	Vermis, cerebellum	Partial removal	Operation	Improved.*
7	31639	Endothelioma	Cerebellopontine angle	None	Previous operation.	Improved.
8	32775	Ependymitis. Internal hydrocephalus.	Fourth ventricle	1. Subtemporal decompression. 2. Cerebellar exploration.	Autopsy	Unimproved.†
9	35309 35731	Cyst	Cerebellum	1. Exploration and decompression. 2. Evacuation.	Operation	Well.
10	35519	Cyst	Intracerebellar	Excision	Operation	Well.
11	34445	Cyst (arachnoidal)	Over cerebellum	Evacuation	Operation	Well.
12	36092	Cystic glioma	Cerebellum	Excision	Operation	Well.

* Dead four months after operation. † Died some time after operation.

SUMMARY OF TABLE II.

Number of cases operated upon.	Number of operations.	Operative mortality.	Case mortality.	Apparently well on discharge.	Improved.	Unimproved.
11	13	15.4%	18%	6	2	1

TABLE III.—PRESUMED CEREBRAL TUMORS; NOT CERTIFIED.

	Surg. No.	Presumed location of lesion.	Operation.	Result.
1	32713	Left cerebral hemisphere	Exploratory craniotomy	Unimproved.
2	31874	Unlocalizable	Right subtemporal decompression	Improved.
3	31786	Hemisphere, left	Exploration and decompression	Unimproved.
4	30791	Unlocalizable	Right subtemporal decompression	Improved.
5	31822	Unlocalizable (metastatic?)	Right subtemporal decompression	Improved.
6	32917	Unlocalizable	Right subtemporal decompression	Improved.
7	33200	Hemisphere, left	Exploratory craniotomy	Unimproved.
8	33359	Unlocalizable	Right subtemporal decompression	Improved.
9	33480 33815	Hemisphere, left	1. Exploration and decompression. 2. Transcortical exploration.	Unimproved.
10	33684	Frontal lobe, left	Exploration and decompression	Improved.
11	31406	Hemisphere, left	None	Not treated.
12	34701	Hemisphere, left	Exploratory craniotomy	Improved.
13	35364	Hemisphere, left	1. Exploration and decompression. 2. Exploration.	Improved.
14	34849	Hypophysis (?), internal hydrocephalus	Ventricular puncture	Unimproved.
15	33012	Third ventricle	Cerebellar exploration	Improved.
16	36048	Unlocalizable	Exploration and decompression	Improved.

SUMMARY OF TABLE III.

Number of cases operated upon.	Number of operations.	Operative mortality.	Case mortality.	Apparently well on discharge.	Improved.	Unimproved.
15	17	0	0	0	10	5

TABLE IV.—PRESUMED CEREBELLAR AND CEREBELLOPONTINE TUMORS NOT CERTIFIED.

	Surg. No.	Presumed location of lesion.	Operation.	Result.
1	35905	Cerebellum	Suboccipital exploration	Improved.
2	33837	Cerebellum	Suboccipital exploration	Unimproved.
3	33683	Cerebellopontine angle	Suboccipital exploration	Dead. In coma when operated upon.
4	32049	Cerebellum (metastatic?)	None	Dead. Died suddenly before operation.
5	30887	Cerebellum	Suboccipital exploration	Unimproved.
6	30999	Cerebellum	Suboccipital exploration	Improved.
7	31636	Cerebellum	Suboccipital exploration	Improved.
8	32022	Cerebellum	Suboccipital exploration	Dead, 24 hours after operation.
9	32523	Cerebellum	Suboccipital exploration	Unimproved.
10	32854	Cerebellum	Suboccipital exploration	Improved.
11	32169	Cerebellum	None	Not treated.
12	31701	Pons	None	Not treated.

SUMMARY OF TABLE IV.

Number of cases operated upon.	Number of operations.	Operative mortality.	Case mortality.	Apparently well on discharge.	Improved.	Unimproved.
9	9	22%	22%	0	4	3

individual surgeons, but as questions influencing the mortality, and the results of surgical procedures in general, still open to discussion.

We have reviewed the cases of brain tumor in patients who have entered the surgical service of Dr. Halsted between September 1, 1912, and January 1, 1915; and in the present communication we wish to consider them for the purpose of commenting upon some of the problems indicated. We wish further to indicate the value in our hands of some of the more common diagnostic aids, to relate a few experiences in the pathology and differential diagnosis of brain tumors, and, finally, to emphasize steps in surgical technic that have favorably influenced our mortality and operative results.

In the 70 cases which form the basis of this report are included conditions other than true brain tumor, *i. e.*, ependymitis, pachymeningitis interna hemorrhagica, encephalitis, arachnoiditis, cerebral tubercle, dural gumma, and aneurism of the internal carotid artery. Yet the symptoms in these conditions simulated so closely those of brain tumor that operations were usually performed under the supposition that a new growth was present. Of these 70 cases, the nature and position of the lesion has been established by us at operation or at autopsy in 40, or 57 per cent; and two additional cases were certified through operations performed by Cushing. The remaining 28 patients presented definite signs and symptoms of brain tumor and in the great majority of instances were operated upon, the operation, however, failing to disclose the lesion. These cases may be grouped as shown in Tables I, II, III and IV.

Of the 70 patients, 62 were operated upon. Of the eight patients not operated upon, six refused operation, one had such extensive pulmonary tuberculosis that operation seemed inadvisable, and one died suddenly in the ward before operation. Seventy-one major operations were performed upon

these 62 patients, *i. e.*, upon several patients, on a second admission, an exploratory craniotomy was performed subsequently to a subtemporal decompression. There were six deaths occurring between 24 hours and five days after operation —an operative mortality of 8.6 per cent; a case mortality of 9.6 per cent. Two patients subsequently died in the hospital, their condition and subsequent death being apparently uninfluenced by our operative procedures. Including these the total mortality is 11 per cent and 12.8 per cent, respectively. There were no deaths upon the operating table. The mortality list, as shown in the accompanying analysis, includes a moribund patient operated upon as an emergency in the last stages of cerebral compression.

1. Surg. No. 33683. **Comatose for three days before admission to the hospital. Operation performed as an emergency with the patient in the last stages of cerebral compression. The patient stood the operation remarkably well, but failed to respond, and died 24 hours later. No autopsy.**

2. Surg. No. 32022. **Operated upon for supposed cerebellar tumor. Lesion not found at operation. There was a considerable amount of difficulty with the anesthesia (cyanosis), but his condition was good at the end of the operation. It remained good during the night, but on the following morning he suddenly became cyanotic, his temperature rose to 103.5° F., his pulse to 170-180. He was given oxygen and improved remarkably; his pulse and temperature dropped, and his cyanosis entirely disappeared. Twenty-six hours after operation he had a second similar attack, and died. No autopsy.**

3. Surg. No. 30873. **Operated upon for supposed cerebellar tumor. Unusually bloody operation, due to the enormous venous sinuses in the occipital bone. In opening the dura an anomalous venous sinus was cut, with a resulting hemorrhage which was controlled with difficulty. Lesion not found at operation. For 20 hours after operation the patient's condition was good. At the end of that time he was seized with numerous convulsions (cerebellar fits), characterized by opisthotonos, extension and internal rotation of the arms, and extension of the legs, with plantar flexion of the feet; Cheyne-Stokes respiration; stupor. On the possibility that perhaps a hemorrhage had occurred from the damaged sinus, the wound was opened, but found to be perfectly dry. Death 24 hours after operation. Autopsy. Tumor about the third ventricle. No hemorrhage.**

4. Surg. No. 32311. **Operated on for right cerebello-pontine tumor. Tumor the size of a walnut found in angle. It was enucleated and the bleeding readily controlled. The tumor, which proved to be a dural endothelioma, was quite adherent to the skull and total extirpation was impossible. Recovery from operation, with difficulty of respiration and speech. Several spells of asphyxia resulted, and the patient died five days later. No autopsy.**

5. Surg. No. 31325. **Cerebellar exploration for a presumed cerebello-pontine tumor. The tumor could not be located at operation, although a good exploration of both cerebello-pontine angles was possible. The operation was uneventful except for a persistent cyanosis. The cyanosis was not lessened by intratracheal insufflation, change of position, or stimulants, and the patient died three hours after the operation. At autopsy, a large infiltrating glioma was found in the medulla and the left lobe of the cerebellum. An enlarged thymus, which constricted the left innominate vein, was undoubtedly responsible for the cyanosis during operation.**

6. Surg. No. 34722. **Left exploratory craniotomy for a tumor presumably involving the left temporal lobe. Operation uneventful. The tumor was not disclosed, and the operation resulted in a decompression. A ventricular puncture was done, but no cerebrospinal fluid was obtained. A drop or two of blood escaped from the needle. For 48 hours after the operation the condition was good. Then there was a sudden rise in temperature to 106° F., great restlessness, numerous convulsions, and death in four hours. Autopsy. A large subcortical glioma was found, extending into the left lateral ventricle. Both ventricles were full of blood, presumably from the puncture of the tumor by the ventricle needle.**

In 33 cases the lesion was disclosed at operation, *i. e.*, in 53 per cent of the cases operated upon. The operative treatment consisted in the attempt to remove the lesion completely in 28 cases; in seven of these we accomplished no more than a partial extirpation. In four cases the size or situation (in the speech area, etc.) of the growth made an attempt at removal unwise. In one case the operation consisted in the partial removal of the dura and hemorrhagic membrane. Thirty-eight operations were performed upon these 33 patients. There was one death, an operative mortality of 2.6 per cent, a case mortality of 3 per cent.

Upon the remaining 29 patients a simple decompression, or an exploratory craniotomy combined with a decompression, was done in 21 instances; a cerebellar exploration and decompression in 13 instances. (In five cases, two cranioplastic operations, or both an exploratory craniotomy and a cerebellar exploration, were done.) The operative mortality in this group of cases was five, or 14 per cent; the case mortality, 17 per cent.

Sufficient data are not yet at hand to enable us to state at present the late results of our operative procedures in these 70 cases; and the determination of the point must be left for a subsequent report. The immediate results may be summarized as follows:

Fifteen patients left the hospital apparently well; 29 were greatly improved, with the relief of all pressure symptoms; 11 remained unimproved. Six patients died within from 24 hours to five days after operation; two patients eventually died in the hospital.

Pathology.—As previously noted, the character and site of the lesions are known in 42 of the 70 cases forming the basis of this report. In 30 cases the lesion involved the cerebral hemispheres, mid-brain and hypophysis; in 12, the cerebellum or paracerebellar regions. The following table indicates the character and location of the lesion:

Type of lesion.	Cerebral hemispheres.	Midbrain.	Hypophysis.	Intracerebellar.	Extracerebellar. (cerebellopontine.) (arachnoidal cysts.) (ependymitis.)
Glioma	14	3	..	3	..
Cyst	3	1	1	5	1
Endothelioma	2	..	..	..	2
Tuberculoma	1	1	..	..	..
Syphiloma	1	..	..	..	..
Encephalitis	1	..	..	..	..
Ependymitis	..	..	..	..	1
Pachymeningitis interna hemorrhagica	1	..	..	..	..
Aneurism, internal carotid artery	1	..	..	..	..

The table shows the large percentage of glioma as compared with other varieties of lesion and the infrequency of the infectious granuloma, tuberculoma and syphiloma.

Gliomata.—Gliomata formed 50 per cent of the total number of lesions in this series. Of the cerebral gliomata, six were cortical, 11 were entirely subcortical. Eleven were diffuse, without a definite line of demarcation from the surrounding cortex; six were more or less circumscribed, in the sense that they allowed of a satisfactory enucleation. Twelve were solid tumors; five had undergone a more or less extensive cystic degeneration.* Of the cerebellar gliomata, two were cortical, one subcortical; two circumscribed, one diffuse; two solid, one cystic.

In all cases the gliomata were comparatively large. In consistence they varied from relatively hard to extremely soft gelatinous growths resembling a colloid carcinoma. In most instances the histological picture was that of a typical glioma; in several cases the closely packed round cells presented the picture of, and could not certainly be differentiated from, a round-celled sarcoma.

Cysts.—Of the 11 cysts which occurred in this series, seven belong to the group of simple serous cysts, one arose from an embryonal *Anlage* (Rathke's pouch?), and three are arachnoidal cysts. Five of the seven *simple cysts* occurred in the cerebellum, which appears to be their seat of predilection. They presented the typical characteristics—a thin, gelatinous wall easily separated from the surrounding apparently normal brain tissue, and a yellowish or slightly brownish fluid which, rich in fibrin, rapidly clotted on exposure to the air. The origin of these so-called simple cysts is not yet clearly understood. Although it may be difficult conclusively to demonstrate this association, they appear to be derived from solid tumors (gliomata and sarcomata) by a process of degeneration. The occurrence of what are apparently cysts having the usual cyst wall and characteristic fluid, but which on careful study show a mass of tumor tissue of varying size in the wall of the cyst, lends support to this view. Councilman,[2] however, states that "the cysts are not the result of cell secretion nor do they represent areas formerly the site of degeneration. They are due to the fluid absorption of the tissue and represent an accentuation of a condition common to the entire tumor."

The cyst arising from an embryonic *Anlage* was about 2 cm. in diameter and lay in the region of the third ventricle. At operation (an intracranial hypophyseal approach) a clear fluid was evacuated, containing numerous shimmering cholesterin crystals. Unlike the usual cystic fluid, it did not clot on standing. The cyst wall (Fig. 1) consists of layers of stratified epithelium, the basal layer columnar and resting upon a sharply defined basement membrane. Above the layer of columnar cells are from 6 to 10 or more layers of flattened epithelium, becoming squamous at the surface. The origin of this cyst from Rathke's pouch seems probable.

* In the classification of cystic lesions, those in which there was a demonstrable fragment of gliomatous tissue are grouped under gliomata; those without demonstrable tumor tissue are grouped under "cysts."

The arachnoidal cysts, three of which occur in this series, form an interesting group of cases. Arising in the majority of instances as a consequence of infection (especially from the ear) or of trauma, they give rise to general pressure symptoms and focal signs simulating tumor. Two occurred over the cerebral hemispheres, one over the cerebellum. As seen at operation, two of the cases presented a local collection of cerebrospinal fluid enclosed by the thickened, opaque pia-arachnoid. In one of these cases the underlying cortex appeared normal; in the other there was a definite atrophy of the underlying convolutions. In the third case the condition was not definitely seen. The patient presented marked pressure symptoms plus nystagmus and staggering gait; and at operation the left cerebellar lobe herniated into the dural defect more markedly than the right. Exploration about the left lobe showed adhesions between the pia and the tentorium, during the separation of which there was a sudden discharge of cerebrospinal fluid. The exact location of this fluid was not determined, but apparently it lay between the cerebellar pia-arachnoid and the tentorium.

The arachnoidal cysts should not be confused with conditions in which, as a result of disturbed cerebrospinal circulation, fluid collects under tension in the various cisternæ. It has been our experience to explore the cerebellum in a case presenting indefinite symptoms, and to find the median cisternæ enormously distended with fluid, and the pia-arachnoid opaque and thickened—a picture, therefore, resembling that of an arachnoidal cyst. The subsequent post-mortem examination showed a large tumor involving the optic thalamus and internal capsule. It is, indeed, frequently observed in explorations for cerebellar lesions that the cisternæ are distended with fluid, and it is a common practice to open them in order to relieve tension. Local collections of fluid are also sometimes observed over tumors (as in those in the cerebellopontine angle).

Endotheliomata.—Of the four patients in this series one was not operated upon by us, but returned with definite signs of local recurrence about three years after a cerebellopontine-angle tumor had been removed by Cushing. Of the three other cases, one occurred in the cerebellopontine angle, two over the hemispheres. One of the latter is interesting, in that it was attached to and apparently arose from the falx cerebri, and for the most part was subcortical, reaching the surface over the lateral aspect of the frontal lobe. At the point where it presented on the surface it had provoked a hypertrophy of the overlying skull so that an X-ray diagnosis of osteoma of the skull had been made.

Although few in number, these cases serve to illustrate the most important surgical aspect of these tumors, *i. e.*, that they may be multiple, and that, unless completely removed with a wide area of attached dura, they are prone to local recurrence. Two of the patients came to us with recurrent tumors; one of these cases, Surgical No. 25006, is an example of recurrent and multiple tumors. The patient, admitted with general pressure symptoms, focal epileptic attacks in the left hand and arm, and a mild grade of motor aphasia, had been operated upon in St. Louis in 1908, and a dural endothelioma lying over the

motor strip had been successfully removed. The aphasia apparently was not accounted for at that time. He entered The Johns Hopkins Hospital in November, 1909, with recurrent symptoms and with more pronounced aphasia. The third exploration was directed farther forward than the first or second. A recurrent tumor was found at the site of the previous operations, and a second tumor, about the size of a walnut, was discovered indenting and compressing the motor speech area. Between the two tumors lay a strip of apparently normal dura, 4 cm. in width. Whether this second tumor should be considered a distinct growth, or a regionary metastasis from a primary tumor, is not clear. Endotheliomata do not as a rule metastasize; and the intervening normal dura does not suggest a direct extension from a primary growth. The possibility of a second tumor arising by implantation from a primary growth should be thought of. That tumors may be multiple and entirely distinct is shown by the occasional occurrence of bilateral endotheliomata in the cerebellopontine angles.

We shall make but few comments upon the cases of tuberculoma, syphiloma, encephalitis and ependymitis that occur in this series. Of the tuberculomata, both were solitary tumors, one in a patient without symptoms or signs of tuberculosis elsewhere; one in a patient showing pulmonary tuberculosis. The cerebral tubercle, although completely broken down, possessed a thick wall (Fig. 2), so that its complete removal without rupture was comparatively easy. The syphiloma occurred in a patient whose only symptom was a persistent headache, confined to a small area over the left temporal region. At operation three small dural gummata, closely grouped together, were removed. The cases of encephalitis and ependymitis presented symptoms and signs characteristic of tumor; in the former the localized affected area was excised; in the latter, which subsequently came to autopsy, no lesion excepting a chronic basilar meningitis and ependymitis was found to account for the high grade of internal hydrocephalus which was present.

Pachymeningitis Interna Hemorrhagica.—The case is of interest from a clinical as well as a pathological standpoint, and therefore is described in some detail.

Surg. No. 34023. Pachymeningitis interna hemorrhagica. General pressure symptoms. Loss of memory, irritability, change in habits, mental dulness. Right exploratory craniotomy with the disclosure of an extensive hemorrhagic membrane. Recovery.

The patient, a male of 26, by occupation a farmer, was admitted to the hospital February 28, 1914, complaining of headache and loss of vision. His past history was unimportant. His present illness began in January, 1913, with headaches and occasional vomiting. There was no history of previous injury to the head; indeed, no etiological factor. The headache was generalized in "a heavy, dull, severe ache" present every morning, becoming less severe in the afternoon. His eyesight began to fail in March and continued to grow steadily worse until he was almost blind. In November, 1913, a decompression was done at another hospital, with relief of the headaches for a month and a half. Since that time they had become progressively worse. He had noticed loss of hearing for the three weeks previous to admission.

Examination.—The patient presented a large cerebral hernia, the result of the previous decompression. This was unusually tense. The positive neurological findings were a high grade of choked disc in both eyes (5-6 diopters); blindness of the right eye, almost complete blindness of the left; convergence palsy of the right eye; marked impairment of hearing in both ears, about equal on the two sides; marked disturbance in memory; irritability and change of habits. The X-ray showed general convolutional atrophy and destruction of the posterior clinoid process. A probable diagnosis of tumor in the frontal region was made.

Operation.—March 4, 1914. A large bone flap was turned down in order to expose the frontal and paracentral regions. The dura mater was under enormous tension and bluish in color over the entire area exposed. From a small preliminary opening made in it, a blood-tinged fluid spurted a distance of six feet. After evacuation of a very large amount of this fluid, the dural tension rapidly diminished. When the dural flap was turned back, a remarkable picture presented. Underneath the dura was a false membrane extending over the entire hemisphere, red in color and in places a centimeter in thickness. Between this hemorrhagic membrane and the dura the fluid previously evacuated had collected. Friable festoon-like adhesions extended from the external surface of the membrane to the dura, the intervening space, therefore, having the appearance of a large multilocular cystic cavity containing blood-stained fluid and blood clots. After the evacuation of fluid and clots, it was evident that there was a continuous slow oozing of fresh blood into the cavity. Some of this fresh blood definitely came from the under surface of the dura, but that this was the only source of the bleeding could not be determined. On cutting through or separating the hemorrhagic membrane, we encountered a second thin and transparent membrane, beneath which was clear cerebrospinal fluid. This membrane suggested pia-arachnoid, but was of greater thickness. It could be lifted from the surface of the cortex, was readily separable from the hemorrhagic membrane, and, so far as could be determined, extended over the entire hemisphere. When this membrane was incised, the cortex was exposed. This also presented an unusual appearance: Along the sulci and blood vessels were yellowish lines and plaques suggesting an old healed infective process. Several of these plaques were excised, and on section proved to be made up of dense fibrous tissue. There was no evidence of a cerebral tumor. A portion of the dura and as much of the hemorrhagic membrane as possible were excised. The wound was then closed.

Post-Operative.—No post-operative complications. The hernia through the decompression defect collapsed after operation, but promptly became tense again. The patient was discharged from the hospital showing little, if any improvement.

Pathological Report.—Section of the tissue excised (Fig. 3) shows the dura considerably thickened and in places infiltrated with small round cells. In one place a large dural sinus appears to open directly into the hemorrhagic area. Intimately in contact with the dura (a condition not present at operation and due to fixation), but sharply demarcated from it, is the hemorrhagic layer. It consists almost entirely of red blood cells, with here and there an infiltration of small round cells and fibroblasts. The inner surface of this layer appears to have an epithelial covering. The second membrane is a distinct layer not to be confused with the epithelial covering of the hemorrhagic membrane. In structure it resembles dura.

Comments.—The condition is well known, although rare. The etiology is obscure. Virchow thought that the primary condition was a meningitis, the hemorrhage being secondary. Later observers, among others Trotter,[3] have believed that the hemorrhage is primary, often due to trauma, and that the bleeding arises from the rupture of veins crossing from cortex to dura. The condition is rarely, if ever, correctly diagnosed, owing to the variability in its symptomatology. Trotter has

recently reported a series of cases associated with trauma; it has been an unexpected finding in operations performed for epilepsy; it has been an unexpected post-morten finding in individuals dying in institutions (Fig. 4).

Aneurism of the Internal Carotid Artery (Bilateral). Surg. No. 31628. Bilateral intracranial aneurism of the internal carotid arteries. Symptoms and signs of brain tumor. Calcified mass demonstrable by X-ray. Right subtemporal decompression. Complete relief of all pressure symptoms. Death 18 hours after operation. Autopsy.

The patient was a telegraph operator, 26 years of age. His symptoms began four years before admission with sudden violent frontal headache, nausea and vomiting. These symptoms persisted for six months, then gradually subsided. Loss of vision in the left eye began soon after the onset and progressed until this eye was completely blind. Disturbance of vision followed in the right eye and progressed very slowly. External strabismus of the left eye had been noticed for some time. Forgetfulness and mental dulness were evident.

Examination.—Positive findings: Suggestive parchment crepitus of skull over left temporal region. Left unilateral exophthalmos, but without pulsation. Optic atrophy in the left eye. Choked disc with swelling of 4 diopters and with hemorrhages and exudates in the right fundus. Complete blindness in the left eye; one-half normal vision with a contracted form field and a temporal hemianopsia for colors in the right. Paralysis of the left N. VI, and of the left N. V, both sensory and motor. Suggestive weakness of the right side of the face. Slight weakness of the grip in the right hand. Active reflexes, but equal on the two sides. The X-ray (Fig. 5) shows a series of shadows, consisting of broad, curved lines and plaques. Wassermann reaction negative.

Operation.—The patient, following the advice of his family physician, refused an extensive operation; therefore, only a right subtemporal decompression was done.

Post-Operative.—The choked disc in the right eye promptly subsided. The patient returned to his work and continued actively working for a year. He then gave up his position because of a reduction in his salary as a result of mistakes in the transmission of telegraphic messages. He felt perfectly well; was without headache, nausea, or other symptoms. Suddenly, 18 months after operation, he was aroused from sleep with terrific headache and vomiting, shortly became unconscious, and died within an hour.

Autopsy.—A view of the base of the brain (Fig. 6) shows a large aneurismal mass occupying the left temporal fossa and extending beyond the median line to the right. It was, at the time of removal of the brain, entirely covered by the dura and attached to the bone at the carotid canal. Upon the right side is a second smaller aneurism, 3.5 x 2 x 2 cm. in diameter, which has eroded the floor of the sella turcica. The hypophysis lies between the two masses, much compressed and flattened. The large mass, on being separated from the brain, shows clearly the internal carotid artery entering and leaving it at almost opposite poles. These vessels are about normal in size. The mass measures 24 cm. in circumference and 8 x 7 x 7 cm. in its various diameters. Its surface is smooth and roughly spherical, with the exception of three projecting knobs. On section, the wall of the aneurism varies from 1 cm. in thickness to paper thinness, and shows numerous areas of calcification. The sac is entirely filled with a dense laminated clot which can be lifted out *en masse*, and is entirely solid except for a narrow channel extending through the clot. The base of the brain, after removal of the mass (Photograph, Fig. 7), shows an almost complete destruction of the tip of the left temporal lobe. The mid-brain is compressed and dislocated to the right. The optic chiasm is rotated through an angle of 90°, so that it lies flattened against the mesial aspect of the right frontal lobe. On section of the brain, the right ventricle is dilated, the left collapsed. The tip of the left temporal lobe has undergone an extensive cystic degeneration.

Examination of the skull after removal of the brain shows complete destruction of the posterior wall of the left orbit, destruction of the left anterior and both posterior clinoid processes, partial destruction of the right anterior clinoid process, and erosion of the floor of the sella turcica.

Comments.—The condition should have been correctly diagnosed; indeed, it was strongly suspected by Dr. Henry M. Thomas, who saw the patient with us. The sudden onset with terrific headache and vomiting, followed by a long interval (four years) without marked increase in the symptoms, indicated a vascular lesion; although a sudden hemorrhage into a vascular tumor might have given identical symptoms. The X-ray picture was striking; although we had never seen a similar picture, in retrospect, we should have considered that in no condition would concentric layers of calcification be so likely to occur as in a thick-walled, aneurismal sac. Although upon the left side the wall of the aneurism had eroded the orbit and lay against the fat behind the eye-ball, there was absolutely no pulsation of the globe, that is, no pulsating exophthalmos, and no bruit on auscultation over the skull. This may be explained by the rigidity of the walls of the aneurism due to the calcification and the almost complete filling of the sac with organized tissue. The cause of the sudden increased intracranial pressure leading to death was not determined; there was no rupture of either aneurism.

*Symptomatology and Diagnosis.**—It is not our purpose in the present paper to enter fully into the symptomatology and diagnosis in these cases, but rather to re-emphasize two of the possible causes of late interference in brain tumor cases and to indicate from our experience the value in our hands of some of the common aids in diagnosis.

One of the most important signs of an intracranial new growth is choked disc; and a subjective complaint of disturbance in vision may be a relatively early symptom. Yet, as has been repeatedly noted, even a high grade of choked disc is not incompatible with good vision; and perhaps this fact, more than any other, is responsible for the number of cases of blindness which occurs in every brain-tumor series.

Seven, or 10 per cent, of our patients were blind on admission, and in four others, vision was almost gone. There seems to be at present less confusion in the recognition and interpretation of choked disc; but how long surgical treatment may be safely delayed in the presence of this condition, is apparently as yet not clearly understood. It has been frequently urged that even in the absence of localizing signs, surgical measures should be contemplated as soon as a choked disc can be diagnosed; and we believe that the adoption of this teaching would in large measure prevent blindness. The time during which a choked disc may persist without causing permanent damage to vision is indeterminate; and when permanent injury to the nerve fibers has occurred, progressive loss of vision and even

* In the diagnosis of the cases included in this series we have had the assistance of Dr. H. M. Thomas, to whom we wish to express our indebtedness.

FIG. 1.—Cyst in the region of the third ventricle arising presumably from Rathke's pouch. *a*. Cyst cavity. *b*. Stratified epithelium forming the wall of the cyst.

FIG. 2.—Broken-down cerebral tubercle, removed at operation unruptured, opened to show the thickness of the inflammatory wall.

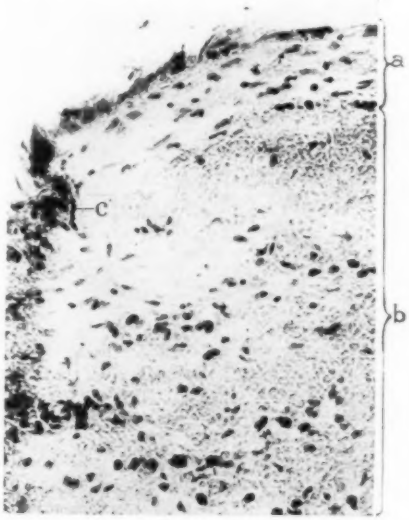

FIG. 3.—Section through hemorrhagic membrane. *a*. Dura mater. *b*. Hemorrhagic layer. *c*. Dural vessel apparently opening directly into hemorrhagic layer.

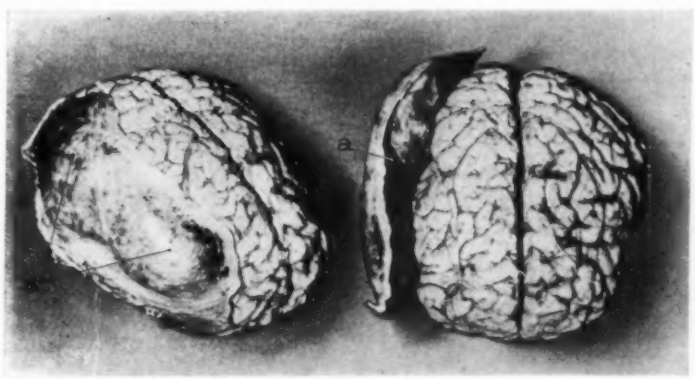

FIG. 4.—Case of unsuspected pachymeningitis interna hemorrhagica dying at Bay View Hospital. (Kindness of Dr. Bogga.) *a*. Dura over the hemorrhagic layer; in the photograph to the right the dura and hemorrhagic layer are reflected from the brain.

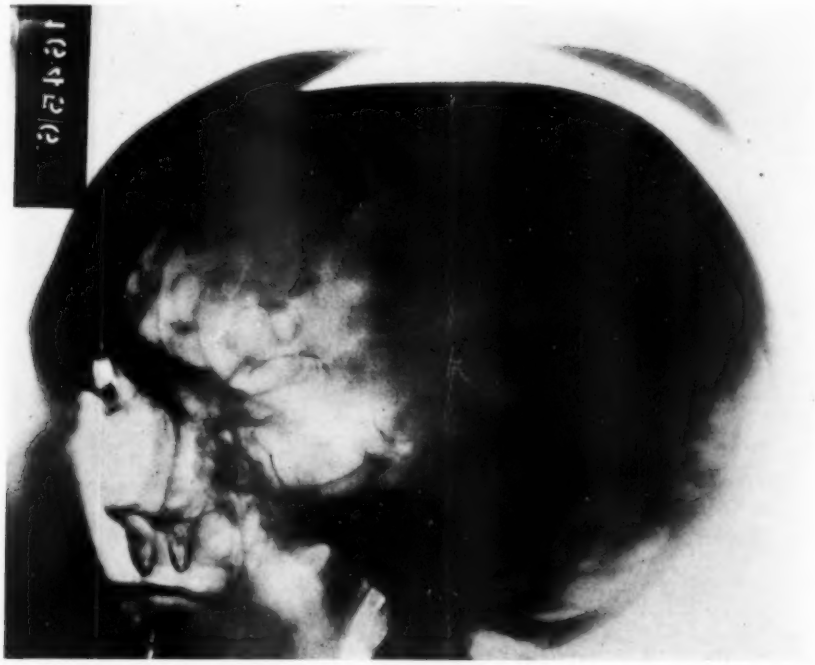

FIG. 5.—X-ray plate of a case of bilateral aneurism of the internal carotid artery. The areas of calcification in the aneurismal wall are seen as a series of broad, curved lines.

FIG. 6.—Case of bilateral aneurism of the internal carotid arteries. The smaller aneurism upon the right side is covered by the larger mass.

FIG. 7.—Case of bilateral aneurism of the internal carotid arteries. Aneurisms removed to show the compression and destruction of the top of the left temporal lobe.

blindness may supervene in spite of an adequate decompression with total subsidence of the choked disc. The demonstration of a normal visual acuity, as tested in the usual way, should not be taken as an indication of the absence of visual disturbance. It is only by careful perimetric examinations that early disturbances in vision can be demonstrated. Contractions in the color fields occur before alterations in the fields for form; and both may occur long before visual acuity, as ordinarily tested, is demonstrably affected.

The assumption, still too prevalent, that intracranial lesions are commonly of syphilitic origin, is another cause of delay in bringing cases into surgical hands. The occurrence of cerebral syphilomata is, in our experience, relatively uncommon as compared with that of true tumors. A single case of dural gumma occurred in the 40 cases certified by operation or autopsy. The Wassermann test was made in 53 cases. In three cases it was positive; in 50 negative. In one case in which a positive Wassermann reaction was obtained, the lesion proved to be a gumma; in one case, a glioma; and in one, the nature is not certified. The absence of a positive Wassermann reaction, with one exception, in a series of 28 certified cases of true tumor, argues well for the value of this test in excluding luetic lesions; and, although a negative Wassermann test does not positively rule out syphilis, yet it would appear unwise, especially in the presence of failing vision, to adopt antiluetic treatment, as is still commonly done, in the hope that the lesion may be luetic. As a case of glioma and a recent case of dural endothelioma show, syphilis and true brain tumor may coexist; hence a positive Wassermann is no certain indication of a cerebral luetic lesion. Our attitude toward the Wassermann reaction in intracranial conditions with choked disc and demonstrable impairment of vision is the attitude of surgeons toward lesions of the tongue in which a differential diagnosis between syphilis and carcinoma is in question—to use it as a guide for post-operative treatment.*

The *X-ray* as an aid in diagnosis in intracranial conditions still finds its greatest field of usefulness in the diagnosis of hypophyseal lesions; not only in their localization, but, from the associated deformities of the sella turcica, in the determination of their size, direction of growth, and, occasionally, of their character. Aside from hypophyseal tumors, however, the study of the X-ray plates in this series has proved of great aid in the diagnosis of intracranial new growths; for, while tumors producing a definite shadow are unfortunately uncommon, changes in the skull, such as erosion or thickening, vascular changes or changes more or less characteristic of internal hydrocephalus, are not infrequent. The value of the various phases of X-ray changes in intracranial lesions is considered in a paper which will shortly appear.

In this series the Bárány test has not been used frequently enough for us to make any positive statements as to its value in the diagnosis of subtentorial lesions. In two cases in which a cerebellar lesion was found at operation, the test was positive; in two other cases in which the lesion was found, the test was suggestive but not outspokenly positive. In two cases of supposed cerebellar tumor in which the lesion was not found at operation, the test was negative. In two cases in which a careful search of both cerebellar lobes and cerebellopontine angles did not reveal a lesion, the test was absolutely positive. In one case of mid-brain tumor, the test was negative. In these few cases, then, the test has been helpful as corroborative evidence in cases with outspoken clinical signs; in cases in which the diagnosis has been uncertain, it has not been of great aid.

The demonstration of an *internal hydrocephalus* is of considerable value in cases in which a differential diagnosis between supra- and subtentorial lesions is uncertain. As is well known, tumors in either hemisphere rarely produce an internal hydrocephalus, whereas obstruction to the outflow of cerebrospinal fluid is a common accompaniment of tumors about the third ventricle, those compressing the aqueduct and those of the cerebellum. In cases in which the symptomatology and clinical signs leave us in doubt as to whether the lesion is anterior or posterior, the demonstration of an internal hydrocephalus may alone determine the site of operation. As has been noted, X-ray plates are of help in diagnosing internal hydrocephalus; more certain information, however, is obtained from ventricular puncture. This is a comparatively simple procedure, and may be done as a preliminary operation under local anesthesia, with or without the injection of 'phthalein; or at the same time as, and as a part of, the major procedure. The scalp flap turned down over either hemisphere need be only large enough to admit a small burr; and the single precaution necessary is to open the dura sufficiently to see that a cortical vessel is not injured by the introduction of the blunt needle. No untoward result has as yet followed the use of this procedure, but that there is a possibility of danger is shown by a death which has recently occurred following an exploratory puncture in the hope of discovering a cyst. The autopsy showed a hemorrhage into the ventricle following the introduction of the needle into a vascular tumor.

The use of phenolsulphonephthalein to demonstrate an obstruction to the outflow of cerebrospinal fluid, as described by Dandy and Blackfan[1] for cases of hydrocephalus in children, has been employed in only three cases. Yet in each instance the results of the tests were quite striking, showing a complete block to the outflow of cerebrospinal fluid. In one case an intracerebellar cyst was found at operation; in two cases the position of the lesion has not been certified. It would seem that this test might be of considerable value in the diagnosis of intracranial conditions giving rise to a tumor symptom-complex, possibly in the differential diagnosis between cases of true tumor and those of internal hydrocephalus the result of ependymitis, etc., the latter sometimes giving rise to all the pressure phenomena common to tumors, but at autopsy showing no intracranial new growth.

Operative Technic.—In the surgical treatment of intracranial conditions, the approach to lesions and the safe closure of wounds are perhaps of greater importance than similar steps in the treatment of lesions elsewhere in the body. There

* Since the above notes were made two other patients with true tumor (glioma) have shown a positive Wassermenn reaction.

has been a tendency to pay less attention to these steps in cranial surgery and to emphasize the treatment of the lesions themselves. Yet the control of hemorrhage from the scalp and bone, which, under increased intracranial pressure may be extraordinarily vascular, remains one of the most difficult features in cranial surgery. With its attendant shock, hemorrhage is one of the most potent factors in the high mortality generally attending cranial surgery and is responsible in the majority of cases for the adoption of a two-stage procedure. The element of time, so long as hemorrhage is satisfactorily controlled, is of little importance, and therefore in forming osteoplastic flaps, motor-driven have little advantage over hand-driven instruments, aside from lessening the manual labor involved. Nor are the difficulties in the approach to intracranial new growths confined to scalp and bone; for owing to increased intracranial pressure the dura may be under such tension, that the careless opening of this membrane results in the rapid herniation of the cortex through the defect and its rupture with all the attendant complications.

The problem of extirpating intracranial new growths is largely also a problem of the control of hemorrhage, but a problem different from that obtaining in the treatment of malignant tumors elsewhere; for, while in the latter we unhesitatingly occlude all large vessels supplying the lesion, in the former we must preserve vessels the occlusion of which might lead to extensive softening of the brain. Other important factors must be borne in mind. The removal of a tumor, simple in itself, owing to its proximity to or involvement of a vital center or structure, may lead to the death of the patient; or, because of its situation in the speech or motor centers, may leave the patient after its removal in a condition more deplorable than before.

One has merely to read statistical reports, and to recall some of the cases which come to the clinic secondhand, to realize that large, unsightly herniæ, often causing extensive paralyses and fungus cerebri, are too common, and aside from infection are largely the result of a too careless closure of the wound. In the prevention of these complications we believe the transplantation of fascia has been a great aid.

We are by no means satisfied that the control of hemorrhage from scalp, bone and cortex has been satisfactorily solved. Yet we have had, up to the present time, no deaths upon the operating table and no deaths from hemorrhage or shock. In 150 cranioplastic operations for brain tumor and epilepsy, a re-elevation of the bone flap has been necessary only once because of post-operative bleeding; and in the same number of cases a two-stage operation has been necessary but once because of hemorrhage. In 28 cases of partial or complete extirpation of the lesion the case mortality was 3 per cent. In this series there has been no post-operative pneumonia, a result due in large part, we think, to intratracheal anesthesia. We regret to say that in two cases superficial infections (stitch abscesses) occurred.

Types of Operation.—In the treatment of intracranial tumors only four types of operation need be considered; a decompressive craniectomy done for the relief of pressure symptoms in cases of unlocalizable tumors; an osteoplastic resection for the exposure of cerebral tumors (often combined with a decompression); a cerebellar exploratory and decompressive craniectomy for tumors of the cerebellum and cerebellopontine angles; and the nasal or intracranial operation for the exposure of hypophyseal tumors. In the treatment of cerebral and cerebellar lesions we have followed the procedures as developed by Cushing, to whose writings reference may be made for details. (Keen's Surgery, etc.) The subtemporal method of decompression seems undoubtedly the operation of choice for the relief of pressure symptoms due to cerebral tumors; for, as its author has pointed out, the support and protection afforded by the temporal muscle and fascia limit the size of the hernial protrusion, and the operation, done over the relatively silent temporal lobe, avoids the paralyses attending defects made over the parietal and paracentral regions. Whether the subtemporal defect be made over the supposed side of the lesion or upon the opposite has, in our experience, made little difference so far as the relief of pressure symptoms is concerned; and it has been only in cases in which a left-sided exploratory craniotomy has failed to reveal a cortical lesion that a left subtemporal decompression has been done. In spite of great care in the formation of the defect, a temporary aphasia has followed a left subtemporal decompression in two instances.

In the treatment of hypophyseal lesions the nasal approach has been most strongly advocated and most frequently used. Cushing,[8] who has had the largest series of cases, in 124 operations upon 95 patients has used the nasal approach 111 times, the intracranial approach 13 times. Von Eiselsberg,[6] who perhaps has had the next largest series of cases, practically always employs the nasal approach. Frazier,[7] reporting the cases from the literature in 1913, found that 64 out of 74 cases had been operated upon by this method. Notwithstanding the overwhelming support in favor of this type of operation, the further development of hypophyseal surgery would appear dependent upon a satisfactory *intracranial* approach. The nasal operation, except in rare cases of hypophyseal cyst, is a purely palliative procedure; and, while comparatively simple, has the disadvantages of a septic approach, a very limited exposure of the region attacked, and a restricted field of usefulness. The intracranial operations thus far suggested (Krause,[9] Kiliani,[9] Frazier,[10] McArthur,[11] etc.) have been unsatisfactory, in that a more formidable procedure has resulted in but little greater exposure of the hypophyseal region than the nasal approach offers. We have employed now in six cases an intracranial operation which obviates many of the disadvantages of intracranial procedures thus far described, and has the advantage that it gives a wide exposure of the hypophyseal and chiasmal regions. This operation will be described in a subsequent communication.

One-Stage Versus Two-Stage Operations.—Whether an operation be conducted in one or two stages must be left to the individual preference of the surgeon; a preference dependent, in large part, upon the surgeon's mortality. Aside from the patient's aversion to a two-stage procedure, the dis-

advantage of operating in a non-virgin field, and the added dangers from a second anesthesia (pneumonia, etc), from infection and its consequences (meningitis, fungus cerebri, etc.), and from other post-operative complications, would lead a surgeon to complete an operation at one sitting were his mortality low. Recent statistics indicate that, in spite of its disadvantages and added dangers, the two-stage operation is the operation of choice both in this country and abroad; and it is said by its adherents to be responsible for a lowered operative mortality. Very few statements are at hand to show the cause of operative deaths in brain-tumor cases; but that hemorrhage and shock, infections (meningitis), pneumonia, and respiratory paralysis (due to tumor pressure, sudden dislocations, cerebral edema, etc.) are the most common causes, is evident. Of these, hemorrhage with its attendant shock is the most important cause. Together with the occurrence of a tense dura, it is the troublesome factor in the approach to intracranial tumors and is responsible in most instances for two-stage operations. That it and the complications attending surgical operations in general enter largely into the mortality is indicated by the number of deaths following simply the approach to brain tumors, that is, the first stage. Krause,[12] reporting 154 cases of brain tumor operated upon within the 12 years preceding 1913, cites 21 cases operated upon *in one stage*, with a mortality of 65 per cent. Of the remaining 133 patients operated upon in two stages, 29 died at the end of the first stage (before the dura was opened), a mortality of 21.8 per cent. His average mortality in 104 cases of tumor extirpation, done in two stages, was 34 per cent; so that his greatest mortality occurred during the first stage. Von Eiselsberg,[13] in the extirpation of 46 cerebral tumors, had nine deaths, six of which occurred after the first stage; and in 32 cases of cerebellar tumor, 17 deaths, nine of which occurred after the first stage.

It is not our purpose to urge the one-stage operation in preference to the two-stage procedure; but to indicate that the factors responsible for the adoption of the less satisfactory two-stage operation can be largely eliminated. Bleeding which resists all efforts for its control, a badly taken anesthetic, or an unusually tense dura, may determine one to abandon the operation for a second sitting. That this should be an exceptional occurrence rather than the rule has been demonstrated by Cushing; and our present series supports the view in favor of one-stage operations.* In 71 operations done upon 62 patients, a two-stage operation was necessary in but a single case, in which a mistaken X-ray diagnosis of osteoma of the skull led us to attempt to remove an area of extremely vascular hypertrophied bone before discovering the underlying tumor. None of the six deaths in this series could be ascribed to hemorrhage or shock; and in none of the patients that recovered was the condition such that a blood transfusion was deemed advisable. Possibly an unusually favorable series of cases has been responsible for the small number of two-stage operations; but we believe that a careful control of hemorrhage during the approach and subsequently a careful closure of the wound have been the determining factors.

Anesthesia.—The occurrence of cardiovascular and respiratory disturbances of cerebral origin makes the administration of a satisfactory anesthesia more difficult in brain-tumor cases than in other groups of surgical cases. Labored respiration, cyanosis, coughing and straining increase greatly the difficulties of a cranial operation. Aside from its danger as a respiratory hindrance, cyanosis especially causes a great increase in the venous bleeding from the scalp and bone, an engorgement of the cortical vessels, and so great an increase in intracranial tension, that the opening of the dura becomes an exceedingly dangerous procedure. Especially, perhaps, in the cerebellar operations is cyanosis the matter of importance; for with tumors in the posterior fossa causing compression upon the medulla a little cyanosis may be sufficient to cause respiratory paralysis. So essential to the success of intracranial surgery is the administration of a smooth, even anesthesia, that the services of an expert have been considered necessary by surgeons interested in this field of surgery.

In the present series of cases ether alone has been used; and we have had an excellent opportunity of comparing ether anesthesia administered by the usual drop method and by intratracheal insufflation. Watt's [14] report includes this series of cases; and for details reference may be made to his paper. By the use of intratracheal insufflation, the difficulties attending anesthesia in brain-tumor cases have been very largely overcome; and in the last 35 cases in which this method alone has been used, a smooth, even anesthesia, without cyanosis, straining or coughing, has been the rule. Owing probably to the absence of cyanosis, hemorrhage has been distinctly less. The method allows the administration of a constant measured amount of ether, and therefore a constant depth of anesthesia. A striking evidence of this is the change we have noted in the character of our pulse charts. Even when the drop method is employed by an expert, the pulse chart is often represented by a rising and falling curve, due more often to varying depths of anesthesia than to operative manipulations. When the ether is given by the intratracheal method, the pulse chart is represented by a straight line, even in prolonged anesthetizations (three hours). Deviations from this straight line are of greater significance than changes occurring in the rising and falling chart of the drop ether method, and combined with blood-pressure observations they indicate more truly the effects of hemorrhage and operative manipulations. In addition to insuring a smooth anesthesia and to giving more certain information of the condition of the patient, the intratracheal method has other advantages. Among others, it relieves the anesthetist from the burden of holding the patient's jaw and other manipulations often necessary to insure easy respirations; so that he can devote himself more completely to observing the patient's condition. It removes him entirely from the operative field. It provides a satisfactory method of artificial respiration without change of apparatus, should

*** It is possible that in the removal of cerebellopontine-angle tumors the two-stage operation may be preferable to the one-stage. Our experience with tumors in this region is not sufficient to warrant us in expressing an opinion.**

respiratory paralysis occur. The services of an expert, while desirable, could, in the above series, but rarely be employed.

We have but a single observation upon the effects of multiple anesthetizations by this method. The one patient in whose case a multiple-stage operation was necessary was anesthetized three times at about 10-day intervals, with no untoward effects.

Local anesthesia (novocain, 1-400) has been used in only one case—a patient suffering from extensive pulmonary tuberculosis. The entire operation—an exploratory craniotomy for a subcortical cerebral lesion—was completed with surprisingly little pain. It is interesting to note that the only complaints of pain were made when, in reflecting the bone flap, the temporal muscle was pulled upon. The dura, supposed to be a sensitive structure, gave rise to no pain in this case when cut, tugged upon, or pinched. The cortex was entirely insensitive.

Control of Hemorrhage.—This most important factor has occupied very largely the attention of surgeons interested in intracranial surgery. Obviously, bleeding from such different structures requires a variety of means for its control, and often slower, more patient, and less certain methods than the clamp and ligature must be employed. It would serve little purpose to discuss the various means which have been described and used for the control of hemorrhage from scalp, bone, dura and cortex; for we have made use only of those which, although often inadequate, most nearly meet our needs. The subject is dealt with in the various text-books (von Bergman, Keen, etc.), and for many devices useful in controlling bleeding, especially from the dura and cortex, reference may be made to the paper of Cushing.[18]

The numerous forms of clamps, tourniquets, and sutures which have been described are an evidence that the control of bleeding from the scalp has not been satisfactorily solved. In a certain proportion of cases a well-fitting tourniquet is adequate and a perfectly dry approach possible. Very often, however, this is quite unsatisfactory, and bleeding occurs from arteries and veins presumably receiving blood from the skull. It ceases to be useful so soon as its pressure upon the skull at any point is released, a condition which often occurs when an exploratory craniotomy is converted into a decompression. In the closure of wounds it is a disadvantage. If it be loosened or removed before the closure is begun, hemorrhage from the wound margins is too severe; if retained until the closure is completed, we must depend upon the careful approximation of the wound margins to control hemorrhage—a not very safe procedure. Because of these disadvantages we have, in an increasing number of cases, discarded the tourniquet and resorted to the more tedious method of clamping each bleeding vessel, as the scalp incision, tourniqueted on its concave side by the hands of the assistant, is slowly made. The numerous clamps upon the concave side of the incision are well out of the operative field; those upon the flap side of the incision would be troublesome in subsequent manipulations. It is our custom, therefore, to elevate the temporal muscle from the base of the flap at the beginning of the operation, and place a temporary clamp resembling a stomach clamp across the scalp and muscle. This is made just tight enough to occlude the vessels in the flap. The method is not ideal; but it assures a control of bleeding in the approach and, with the clamps upon the concave margin of the wound as a guide, enables us to place our sutures around the bleeding vessels during the closure. We have attempted in a number of instances to tie each bleeding point in the scalp incision; the procedure has prolonged the operation unduly, and has tended to invert the margins of the wound so as to make the subsequent closure more difficult.

In operations upon the cerebellum clamps alone meet the requirements; and literally hundreds must be used to satisfactorily control hemorrhage from the scalp and muscles in the vascular cases. Hemorrhage from the bone is best controlled with wax.

For active hemorrhage from the dura the encircling ligature or the placing of silver clips, as described by Cushing,[18] suffices in the majority of cases. The middle meningeal, or its branches, are the vessels with which we have most often to deal, and usually these are readily controlled. Occasionally, when the upper margin of the bone flap approaches closely the median line, bleeding occurs between the dura and bone, presumably from the longitudinal sinus. Usually such bleeding may be controlled by a temporary pack of dry or moist cotton, or by a piece of muscle. In one case it was necessary to expose and suture the longitudinal sinus. The possibility of an abnormally placed sinus in the dura should be remembered. We have had a single experience—a wide venous lake in the dura over one cerebellar lobe which was so flattened by pressure as to be bloodless. Our usual opening in the dura was followed by an alarming hemorrhage, the source of which was at first not recognized and which was controlled with great difficulty.

Hemorrhage from the pial vessels, if slight, is most satisfactorily controlled either by pressure with cotton or with muscle; or with ligatures of fine silk or silver clips, if from vessels of considerable size. In the removal of a cortical lesion, the tumor is encircled by a double row of ligatures or clips, and the incision through the cortex carried between them; for the control of bleeding from subcortical structures, masses of cotton are temporarily used until the lesion is removed and the individual bleeding points are seen and stopped with ligatures or clips. It is remarkable how quickly the hemorrhage from the cavity left after removal of a lesion ceases when held in check for a few moments with dry cotton; a circumstance due more perhaps to the coagulating properties of the brain substance than to the cotton. In the removal of tumors from more or less inaccessible regions (*e. g.*, the cerebellopontine angle) we depend largely upon a temporary pack—an obviously unsatisfactory method. For securing deeply placed vessels of any considerable size, the silver clips have been most useful. In the intracranial approach to hypophyseal tumors the anterior cerebral artery has been torn twice; in both instances the resulting hemorrhage was successfully controlled with clips.

Treatment of Intracranial Tension.—Under conditions of increased intracranial tension, the opening of the dura becomes one of the most important steps in a cranial operation. If the dural tension is not relieved, the opening of the membrane may

result in rupture of the cortex with all its attendant difficulties and complications, or in the sudden dislocation of structures leading to respiratory paralysis. Relief of dural tension may be accomplished usually by one of four procedures having for their purpose the withdrawal of cerebrospinal fluid; ventricular puncture, lumbar puncture, tapping of the posterior median cisterna, and the gradual withdrawal of fluid between the meninges through a minute opening in the dura. Of these procedures ventricular puncture has perhaps the greatest field of usefulness, being applicable for the relief of dural tension in both cerebral and cerebellar explorations. For the relief of tension over either hemisphere the lateral ventricle is tapped with a blunt ventricular needle either through the operative field or through a separate opening in the skull. For the relief of tension over the cerebellum, the posterior cornu of either lateral ventricle is tapped through an opening in the skull a little above the transverse sinus and 1.5 cm. from the mid-line.

Lumbar puncture, as has been repeatedly pointed out, is a procedure attended by considerable risk to the patient; yet this risk must occasionally be taken in cases of "dry brain," in which no fluid can be milked out from between the meninges and in which ventricular puncture has failed. That it need only rarely be employed is indicated by the fact that only one patient in this series (suffering from a hypophyseal tumor) was subjected to a lumbar puncture during operation. The tapping of the posterior median cistern for the relief of tension over the cerebellum, and the withdrawal (milking out) of fluid from the intermeningeal space for relieving tension over the hemispheres, are done through a minute opening in the dura. In the former procedure the cerebrospinal fluid is discharged as soon as the wall of the cistern is opened; in the latter, it must be gradually expressed along some instrument, such as a grooved director, inserted underneath the dura.

Examination of the Exposed Skull, Dura and Cortex.—The superficial tumors, especially the dural endothelioma and osteosarcoma, may, as is well known, cause erosion and pressure atrophy of the overlying bone. It has been our experience to locate accurately subcortical tumors by the examination of the exposed bone; for they, in their early stages at least, exert their greatest pressure locally. So too, the appearance of the dura, its color, vascularity, opacity, or local thickening may indicate an underlying lesion. Careful examination of the cortex may be productive of a great deal of information. Encapsulated growths offer no difficulty in determining their limits; and usually the cortical infiltrating gliomata indicate their boundaries by color changes and differences in consistence on palpation. Yet in some cases the margins of these tumors are impossible to differentiate from the surrounding cortex. In the location of subcortical lesions palpation and aspiration are our most useful aids; occasionally the local flattening and widening of the convolutions over a growth give an indication of its presence. Palpation of the cortex is difficult and often misleading; in three cases, however, a subcortical tumor has definitely been palpated and subsequently removed. By the use of palpation and aspiration, nine subcortical cysts or cystic gliomata have been discovered. In the discovery of subcortical cerebellar lesions, the comparative size of the two cerebellar lobes has been helpful.

Operability of Brain Tumors.—It should not be forgotten that, in speaking of the operability of brain tumors, we are dealing, for the most part, with malignant tumors; and that, because of anatomical and clinical difficulties, our chances of cure by surgical means are less than in malignant tumors elsewhere in the body. Yet if we except the metastatic tumors (carcinoma, sarcoma, etc.) and possibly the tuberculoma, the true cerebral tumors should, pathologically speaking, offer a better hope of cure; for, although prone to local recurrence, they do not tend to metastasize. The difficulty is that so many are subcortical and inaccessible; or they give so few definite symptoms that we are unable to make an early focal diagnosis. In the vast majority of cases the tumors exposed at the operating table are so large as to preclude the hope of successful extirpation.

The question of the operability of cerebral tumors has been approached from various points of view. Groups of statistics have been prepared showing the late results in cases of tumor extirpation (von Eiselsberg, Cushing, Sargeant and others); and it must be admitted that the results are still very unsatisfactory. Critical examination of patients dying as a result of operation or dying unoperated upon, with the idea of determining the chances of operative removal of the lesions, show a very small per cent of lesions favorable for surgical extirpation. Less enthusiastic observers have compared the survival period of cases untreated by surgery with cases subjected to operation, and find but little difference.

Although our chances of a cure by extirpation of the tumor are at present few, practically every operation may be converted into a palliative procedure; and in fully 50 per cent of all cases we may confidently expect an amelioration or total disappearance of pressure symptoms and a subsequent comfortable existence.

The indication for operation in practically all cases of brain tumor, and the favorable results of palliative operations in cases of unlocalizable tumors, are then quite clearly established. What attitude should be taken in the presence of a cortical or discovered subcortical growth, and how best it may be treated so as to prevent local recurrence, are questions not yet satisfactorily settled. Our comments indicate merely our present attitude and are open to the objection that they are based on our immediate rather than late results of surgical procedures.

Glioma.—This, the most common type of cerebral tumor, is least favorable for operative removal. Occasionally encapsulated, gliomata may be shelled out of their bed almost as satisfactorily as the endotheliomata. Others are comparatively hard tumors, and, although not encapsulated, have margins which can be more or less satisfactorily determined by palpation; they offer some hope of total extirpation, by the removal with them of as wide an area of normal cortex as possible. The cystic tumors, especially those with but a fragment of tumor in the cyst wall, also lend themselves to extirpation, the solid portion of the tumor being removed with the cyst wall. Least

favorable are the soft, sometimes gelatinous, infiltrating tumors, the margins of which cannot be differentiated from the surrounding cortex, and the ramifications of which cannot be followed in the subcortical structures.

With certain reservations, we have deliberately attempted the removal of gliomata whether cortical or subcortical; for we have wished to discover the possibilities in the removal of the different varieties of this tumor, and subsequently to determine the percentage of recurrences and the duration and degree of comfort of life after removal. The exceptions to this rule have depended more often upon the situation of the lesion than upon its character. We have thus far been unwilling to remove a large glioma from the speech area, if speech has in a measure been retained; and we are often doubtful whether or not to attempt the removal of a growth from the motor strip in the absence of paralyses, if the character of the growth leaves the possibility of its total removal in doubt. It is well known that intact nerve fibers may penetrate a tumor so that paralyses may be absent; but there seems little doubt that paralyses eventually occur. We have been impressed with the remarkably few cases in which, even with the removal of large tumors, paralyses have occurred. At the present writing we are unable to say from personal observation whether an incomplete extirpation of a growth is less satisfactory as regards comfort and prolongation of life than a simple palliative operation. The results of others would tend to support this view. Our immediate results have been satisfactory. The mortality in extirpations has been low, the post-operative paralysis insignificant, the relief from pressure symptoms prompt.

Since gliomata do not tend to metastasize (aside from the tumor infection of the meninges) our operative efforts need to be confined to the local condition. Since it is often so difficult to determine the margins of the growth, as wide an excision of the surrounding normal cortex should be attempted as is consistent with the least possible paralysis and the preservation of important cortical vessels. In closing the wound, the pial edges are sutured, if feasible.

Endotheliomata.—These are favorable, if not the most favorable, tumors for surgical removal. That the results have not been better has been due to the high operative mortality; for these growths are sometimes exceedingly vascular and their common occurrence in the cerebellopontine angle makes their approach difficult and the post-operative complications (respiratory paralysis) frequent. Although encapsulated tumors, they may be firmly attached by a pedunculated or sessile base to the meninges; and, unless the base or origin of the growth is removed, there remains the possibility of local recurrence. That this is of common occurrence is indicated by statistics. In addition to overcoming technical difficulties and avoiding post-operative complications, our efforts, then, should be directed to preventing local recurrence. In the case of tumors in the cerebellopontine angle this is very difficult, and often we must content ourselves with breaking off a tumor at its base, leaving some fragment behind. Over the cerebrum the problem is less difficult; and with the transplantation of fascia at our command, we may and should remove with the tumor a wide area of attached dura.

Cysts.—These are, pathologically, perhaps not so favorable, but surgically (because attended by a much lower mortality) they are more favorable for treatment than the endotheliomata. They tend to refill after evacuation, and therefore simple withdrawal of the cyst contents should not be considered sufficient. Nevertheless, cases are known in which simple aspiration has resulted in a cure. It is usually possible to remove more or less completely the cyst wall, which appears as a soft, gelatinous structure easily separated from the surrounding brain. It is questionable whether iodine or other irritating substances should be used to provoke inflammation and subsequent adhesion of the opposing cyst walls. The procedure has its analogy in the treatment of cystic conditions elsewhere; but it would seem that the irritating effect of the substance would tend to a more rapid refilling of the cavity. We have had no experience with the treatment of parasitic cysts.

Our personal experience with other lesions has been too slight to warrant comment.

Transplantation of Fascia.—The transplantation of fascia lata has been a helpful procedure. Most ideally it has been used to cover large dural defects left after the removal of tumors that have arisen from or have been firmly attached to this membrane; or in cases in which both dura and bone flap have had to be removed. The area of dura which may be removed is almost unlimited; for from the lateral aspect of the thigh a piece of fascia lata as large in area as the ordinary bone flap may readily be obtained. In a recent case a piece of fascia was successfully transplanted into a dural defect 12 x 11 cm. in diameter.

The procedure has a further field of usefulness in cases in which subsequently to operative manipulations the dural flap cannot be satisfactorily closed over the protruding cortex. This is not of uncommon occurrence. The removal of a cortical or subcortical tumor is sometimes followed by a rapid edema causing the brain to herniate through the dural defect and making the closure of the dural flap impossible. The usual procedures under these circumstances have been a ventricular or a lumbar puncture, or to make a subtemporal defect in bone and dura and crowd the cortex through this defect as the margins of the dural flap are approximated. Whether or not a decompressive defect is deemed advisable, the transplantation of fascia in these cases would seem a better procedure and has been satisfactorily employed in a number of instances. Radiating incisions are made in the dural flap so as to produce a general protrusion of the cortex rather than a local protrusion, in danger of strangulation; after which the margins of the dural flap are approximated as far as possible without tension. Over the whole is transplanted a flap of fascia, the lower margin of which, in cases in which a subtemporal defect is deemed advisable, coincides with the upper margin of the bone defect.

In a single case in which a local collection of cerebrospinal fluid occurred over a subtemporal defect, necessitating frequent tapping (a condition simulating an arachnoidal cyst), the removal of the pseudomembrane and the transplantation of

fascia over the cortical protrusion promptly relieved the condition. It is possible that such a procedure might relieve a similar condition occasionally seen following cerebellar operations.

The transplantation of fascia has been very satisfactory in two cases in which a subtemporal decompression was inadequate for the relief of pressure symptoms, and in which the removal of the entire bone flap seemed advisable. A very large opening in the dura diminished the chances of strangulation of the cortex; and the transplantation of fascia over the dural defect gave, we believe, an added support to the scalp and perhaps helped to limit the size of the protrusion.

In the treatment of post-traumatic epilepsy with extensive adhesions between cortex and dura, we have in three cases excised the roughened dura and transplanted fascia into the dural defect.

In the present series we have transplanted fascia in nine cases. The fascial transplant has healed in perfectly in every instance. There has been no case of infection. In only one case have we had an opportunity of subsequently examining the transplant. In this case the old operative wound was reopened six months after the transplantation of fascia. The entire transplant was intact, vascular, and its structure, as indicated by the striations seen in the freshly exposed fascia lata, was preserved. The line along which it was united to the normal dura was almost imperceptible; but could be followed by the perfectly healed-in, black silk sutures. Most unfortunately, a fragment of the transplant removed for microscopic section was lost.

The technic, as we have used it, is simple. The transplant is merely spread over the defect and sutured to the dura with a series of interrupted fine, black silk stitches.

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EXPERIMENTAL TUBERCULOUS MENINGITIS.

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Tuberculosis of the meninges in man is usually secondary to a tuberculous focus in some other part of the body. The prognosis in this condition is bad, the therapy futile.

Experimentally, to find an efficacious method of treating tuberculous meningitis requires as a prerequisite the production of a condition resembling that met with clinically. This is a difficult task, for, though in experiments on animals a disseminated and miliary infection is readily brought about, lesions in the meninges fail to develop, perhaps as a result of the activity of the choroid plexus.

A survey of the literature reveals little, except that localized tuberculosis of the meninges has been produced by the direct introduction of tubercle bacilli into the nervous system, and that after the production of the local disease systemic invasion may occur.

Manwaring[1] carried out experiments on dogs. He made a trephine opening in the skull, replaced the removed bone with a disc of paraffin and allowed the sutured wound to heal. At a subsequent time, an inoculation of bacilli was made by means of a long, blunt hypodermic needle passed through the coverings of the head, the paraffin disc and the frontal lobe of the brain, to the base of the skull. Tubercle bacilli of the human and of the bovine type, injected according to this technic, gave rise to the development of a tuberculous meningitis followed by paralysis and death. When, after the injection of the bacilli, suspensions of canine leucocytes were introduced into the subdural space, a delay in the development of the paralysis uniformly occurred, and the life of the animal was often prolonged. When the in-

[1] W. H. Manwaring: Jour. Exp. Med., 1912, XV, 1; 1913, XVII, 1.

fecting bacilli were of low virulence, the onset of the paralysis in the treated dogs was deferred for longer than seven months, whereas in the untreated control dogs paralysis developed within four weeks.

This paper records the results of a series of experiments made with the idea of attempting to find some measure of use in treating tuberculosis of the meninges. The observations were made on rabbits, inasmuch as monkeys and dogs were not available for the work. Healthy animals of approximately the same weight were chosen and all were kept under similar conditions.

There are certain disadvantages in the use of the rabbit. The spinal cord extends the length of the spinal canal, so that, when an injection into the spinal subdural space is attempted, it is difficult to avoid injuring the nervous tissue. Again, under normal conditions spinal fluid is present in so small amount that withdrawal of it by aspiration is not possible, and when the spinal canal is opened, not more than a drop or two is to be found. This paucity of fluid, noted even after inflammation of the meninges has developed, deprives us of the intravitam means of estimating the progress of the infection and of determining the effect of treatment upon it.

In some of the experiments described, Manwaring's method of inoculation was used. With a small trephine a button of bone was removed from the skull of a rabbit. The opening thus made was sealed with paraffin, and, after closure of the wound with catgut sutures, healing was permitted to take place. After the lapse of from 5 to 12 days an injection of a suspension of tubercle bacilli was made through a long, slender needle that was passed through the skin, the subcutaneous tissues, the paraffin plug, and the brain, into the subdural space at the base of the frontal lobe.

This method, though readily carried out, is complicated and necessitates injury to the brain. Lumbar puncture was therefore attempted, and it was found surprisingly easy. The hair over the lumbo-sacral region was closely clipped, the skin then shaved and cleaned with tincture of iodine. The rabbit, after receiving a light ether narcosis, was placed on its abdomen and a small needle was passed between the spines of two lower lumbar vertebræ. Entrance into the spinal canal was recognized by a characteristic tactile sensation, and occasionally by a contraction of a hind leg or of the tail, if the spinal cord was touched.

The needle in proper position, a small Record syringe was affixed to it and the injection was made. A full-grown rabbit will readily tolerate the introduction of 2 cc. of fluid into the spinal canal, provided only slight pressure be used and the material be injected slowly. Generally, symptoms due to increased intracranial pressure developed during the procedure. The most constant of these were dyspnea, apnea sometimes lasting for 15 to 20 seconds, periodic respiration, retraction of the head and cervical rigidity of 20 to 30 seconds' duration, and generalized clonic spasms. In two instances, unilateral exophthalmos developed, to subside again within three minutes.

Spastic paralysis of one or both hind quarters was the only residual sign noted. It resulted from injury to the cord in nearly one-half of the animals in this series.

That material injected by lumbar puncture was distributed within the spinal canal was readily demonstrated. One and a half cubic centimeters of an aqueous solution of methylene blue, introduced under very little pressure through a needle inserted into the spinal canal in the lumbo-sacral region, spread within five minutes to the middle or upper thoracic region. The results of the experiments to be described show further that the inoculated material penetrates into the skull.

Thirty-five rabbits were utilized in making the following observations. Twenty received inoculations of the bovine type of tubercle bacilli, and 15 were injected with bacilli of the human type.

The strains used were:

(a) BI, a typical Bacillus tuberculosis of the bovine type, received from an outside source and of low virulence for rabbits.

(b) H39, a Bacillus tuberculosis of the human type, obtained through the courtesy of Dr. A. K. Krause, of Saranac Lake, and only moderately virulent for rabbits.

The bacilli were grown on the surface of glycerin agar and the suspensions for injection were prepared according to a constant technic. The growth of a culture two weeks old was suspended in 0.85% salt solution, thoroughly agitated with sterile glass beads in a mechanical shaker, and filtered through sterile cotton to remove coarse clumps. The resulting suspension was then diluted with salt solution to the approximate density of a 0.05% solution of lecithin in 0.85% salt solution.

From 1.0 to 1.5 cc. of such a suspension were slowly injected with very little pressure into the spinal canal, either through a needle inserted into the canal in the lower lumbar region, or into the cranial cavity according to the procedure of Manwaring already outlined.

The results of the inoculations are seen in the six protocols here given in detail. To avoid unnecessary repetition other experiments are not described.

PROTOCOLS.

Nov. 19, 1914. Rabbit 309. White female. Wt. 1800 gm. Lower back clipped, shaved and cleaned with tincture of iodine. Needle inserted into the spinal canal between the spines of the last two lumbar vertebræ. No fluid could be withdrawn by aspiration. Fifteen cc. of a suspension of BI, prepared as already described, were slowly injected while the animal was recovering from a light ether anæsthesia. There were no signs of injury to the spinal cord. For twenty minutes after the injection was completed, the rabbit remained dull and inert, lying on its abdomen with spread legs and making violent chewing movements.

Ten minutes later, except for the presence of a clonus in both hind quarters, the animal appeared normal and it continued so until six days later, when it seemed duller than usual.

Nov. 26, 1914. Marked emaciation. There was definite ataxia of the left hind leg.

Nov. 30, 1914. Animal weighed 1500 gm.

Dec. 3, 1914. There was no visible advance in the progress of the infection until this forenoon, when a striking change became manifest. The rabbit was prostrated, had a flaccid paralysis of the

fore legs and spasticity, but no paralysis of the hind legs. There were no other signs of meningeal irritation.

Dec. 4, 1914. The rabbit died after an attack of generalized clonic convulsions.

Autopsy.—Emaciated rabbit. Wt. 1400 gm. Examination of the abdominal and thoracic viscera and of the lymph glands showed no evidence of tuberculosis.

There was marked congestion of the meningeal vessels over the entire spinal cord, especially over the thoracic portion. The cerebral meninges likewise showed marked engorgement of the vessels, of maximal degree over the base of the brain and in the basal sulci. No tubercles were seen. There was a slight excess of opalescent fluid over the medulla and in the cerebellopontine angle. On section, no dilatation of the ventricles was found.

Smears from the meninges over the brain-stem and from the base of the brain showed many mononuclear cells, a few extracellular and two intracellular acid-fast bacilli.

Microscopic examination showed the presence of a meningeal (pial) exudate, rich in mononuclear cells and containing many polymorphonuclear leucocytes. The exudate extended into the substance of the cord along the intraspinal prolongations of the pia. There was also marked infiltration of the perivascular sheaths of the small arteries.

Nov. 20, 1914. Rabbit 310. Black and white male. Wt. 2160 gm. Lower back clipped, shaved and cleaned with tincture of iodine. The animal was etherized and a needle was inserted between the last two lumbar vertebræ into the spinal canal. No spinal fluid could be obtained by aspiration. One and a half cc. of the standard suspension of BI were slowly injected with little pressure into the subdural space. Immediately there developed coma, slowed and deepened respiration and a spastic paralysis of the left hind quarter. Recovery was complete within 35 minutes except for persistent paralysis of the left hind leg.

Nov. 23, 1914. The animal appeared normal except for the paralysis noted and for weakness of the right hind leg.

Nov. 27, 1914. In addition to the spastic paralysis there was loss of sphincter control and marked tactile hyperæsthesia. Emaciation marked; wt. 1700 gm.

Nov. 28, 1914. The symptoms had become much more severe in the previous twelve hours. There was extreme retraction of the head, cervical rigidity, intermittent generalized clonic contractions of the muscles and extreme hyperæsthesia of the skin.

Nov. 30, 1914. The foregoing symptoms persisted and the animal died on the eleventh day after inoculation.

Autopsy.—Emaciated rabbit in opisthotonic position. Wt. 1500 gm. Examination of the thoracic and abdominal viscera showed no evidence of a disseminated tuberculosis.

Examination of the central nervous system showed thickening and turbidity of the spinal meninges, especially over the thoracic portion of the cord, but no gross exudate. There was marked engorgement of the pial blood vessels over the spinal cord and the base of the brain, but no tubercles were seen.

Smears from the meningeal surfaces contained a few extracellular acid-fast bacilli, one bacillus in a large mononuclear cell and one in a small mononuclear cell.

On microscopic examination a meningeal exudate predominantly of mononuclear cells was found. There was marked infiltration of the perivascular tissue about the small arteries with small mononuclear cells, extension of the process along the prolongations of the pia into the cord, and a large fresh sub-pial tubercle over the dorsum of the lower thoracic cord. The structure of this tubercle was characteristic and showed beginning central necrosis. In the lumbar cord there was extensive involvement of the parenchyma. Over the pons there was an exudate similar to that found over the spinal cord.

Nov. 20, 1914. Rabbit 311. Black male. Wt. 2160 gm. The lower back was clipped, shaved and cleaned with tincture of iodine. The rabbit was etherized, a needle was introduced into the spinal canal between the two lowest lumbar vertebræ and 1.5 cc. of the standard suspension of BI were slowly and gently injected. Coma promptly developed, with a short period of apnea, and there was transitory spasticity of the right hind leg. Within an hour recovery was complete, no evidences of injury to the spinal cord persisting.

Nov. 24, 1914. Yesterday slight ataxia of the hind legs developed and to-day they are somewhat spastic.

Nov. 30, 1914. The hind quarters have gradually become more paretic and now show almost complete spastic paralysis. The head is retracted and there is definite rigidity of the neck.

Dec. 1, 1914. The animal is dull and torpid; it lies on its abdomen and shows a spastic flexion paralysis of the hind quarters, loss of sphincter control, retraction of the head, generalized hypertonus of the muscles, hyperæsthesia of the skin and photophobia.

Dec. 3, 1914. The symptoms present 40 hours ago persist. In addition there are paralysis of all four extremities, opisthotonos and Cheyne-Stokes breathing.

Dec. 5, 1914. The animal was found dead in its cage.

Autopsy.—Emaciated rabbit. Wt. 1500 gm.

The general examination showed no evidence of tuberculosis except in the spleen, in which two pin-head yellow tubercles were seen.

When the vertebral column was opened the following changes were noted:

The blood vessels of the pia were engorged with blood throughout the length of the spinal cord. There was a slight excess of turbid spinal fluid present, but no gross tubercles were seen. Over the base of the brain, especially about the optic chiasm and the pons, the meninges had a gelatinous appearance.

Examination of stained smears made from the meningeal surfaces showed numerous large and small mononuclear cells and two intracellular acid-fast bacilli.

A study of microscopic sections showed an abundant meningeal exudate of mononuclear and polymorphonuclear cells, and perivascular infiltration with lymphocytes.

The inoculation into the peritoneal cavity of a guinea-pig of 3 cc. of the blood of this rabbit, aspirated from the heart 42 hours before its death, caused the development of typical tuberculosis.

Jan. 6, 1915. Rabbit 313. Gray male. Wt. 3215 gm. The lower back was clipped, shaved and cleaned with tincture of iodine. After the administration of a small amount of ether, a needle was passed between the two lowest lumbar vertebræ into the spinal canal and 1.0 cc. of a standard suspension of H39 was very slowly and gently injected. Signs of increased intracranial pressure promptly appeared—torpidity, deepening to coma, and slow periodic respiration. Recovery took place in 45 minutes, when it was noted that both hind quarters were paralyzed.

Jan. 22, 1915. The condition of the animal remains unchanged except for the emaciation which has been progressive. Wt. 2950 gm.

Jan. 29, 1915. During the past 24 hours loss of sphincter control, excitability and intermittent retraction of the head, have developed.

Feb. 1, 1915. Dull, difficult to rouse; respiration slow and deep. In addition to the signs already noted, there are persistent retractions of the neck, moderate generalized muscular hypertonicity and occasional clonic movements of the fore legs.

Feb. 3, 1915. Yesterday the animal lay in coma and this morning was found dead in its cage.

Autopsy.—Emaciated rabbit. Wt. 1750 gm.

There were no evidences of tuberculosis found in the general examination of the body.

The spinal meninges showed moderate engorgement of the vessels, but there was no excess of spinal fluid, and no tubercles were seen.

The pia over the convexity of the cerebrum showed marked overdistention of the vessels, and over the base there was definite "steaming" of the pia; but no gross exudate or tubercles were seen. Over the dorsal surface of the pons the pia was quite opaque.

Examination of stained smears, made from the meninges at the base of the brain, showed a few large mononuclear leucocytes and scattered acid-fast bacilli.

Microscopic examination showed the presence of a cellular exudate over the pia, and moderate perivascular infiltration with small mononuclear cells.

Feb. 13, 1915. Rabbit 329. Black male. Wt. 2400 gm. After routine preparation, and while the animal was slightly under ether, a needle was passed between two lumbar vertebræ into the spinal canal and 1.5 cc. of a standard suspension of H39 were slowly injected.

The only signs of pressure that developed were torpor, retraction of the head and dyspnea. These subsided after twenty minutes, and the animal seemed quite normal.

Feb. 23, 1915. No signs of infection appeared until this forenoon, since which time the hind legs have become spastic and paretic.

Feb. 24, 1915. There is now complete spastic paralysis of the hind quarters, and weakness of both sphincters. The rabbit is restless and rapidly emaciating.

Feb. 27, 1915. Four cc. of blood were aspirated from the heart for inoculation into a guinea-pig.

March 3, 1915. Very dull and inert most of the time, but at intervals there are periods of spontaneous restlessness, during which the animal emits loud cries and makes rapid convulsive movements of all four extremities and of the facial muscles.

March 4, 1915. The rabbit died in convulsions at 11 a. m.

Autopsy.—Emaciated rabbit. Wt. 1500 gm.

The general examination did not show any tubercles in the glands or viscera.

On opening the vertebral column an extensive extra-dural tuberculosis was seen extending along the bodies of the vertebræ of the upper sacral and lower lumbar regions. A thick firm caseating exudate lined the inside of the dorsal aspect of the spinal column, and on the ventral concavity of the vertebræ a hæmorrhagic exudate, studded with tubercles, was present. This exudate was firmly adherent to the dura and pia over the spinal cord, both of which showed numerous miliary grayish translucent tubercles. The vessels of the spinal and cerebral meninges were distended with blood. At the base of the brain there was a slight excess of turbid fluid and there were numerous translucent miliary tubercles along the arteries.

Examination of stained smears made from the meninges showed numerous mononuclear cells, a few polymorphonuclear leucocytes and an occasional acid-fast bacillus.

Examination of microscopic sections showed typical lesions of tuberculosis—a meningeal exudate rich in mononuclear cells; perivascular infiltration with lymphocytes, a proliferative endarteritis, typical tubercles, and extension of the morbid process into the sulci.

The guinea-pig inoculated with the blood obtained from this rabbit five days before it died failed to develop tuberculosis.

Feb. 13, 1915. Rabbit 330. White male. Wt. 2250 gm. Lumbar puncture was made as in the experiments already described, and 1.5 cc. of a standard suspension of H39 were slowly and gently injected into the lumbar spinal canal. During the inoculation there were transitory jerkings of the hind legs and tail, and apnea of ten seconds' duration. Within ten minutes the rabbit seemed quite normal and continued to appear so for ten days.

Feb. 24, 1915. During the last 20 hours a spastic flexion paralysis of both hind legs has slowly developed and there is hyperæsthesia to the touch.

Feb. 25, 1915. In addition to the signs already noted, there have developed emaciation, photophobia and anisocoria (the right pupil is definitely wider than the left).

Feb. 27, 1915. All of the symptoms have become more marked since yesterday. There is also retraction of the head, and whenever the animal is stimulated generalized clonic convulsions result.

Feb. 28, 1915. The rabbit was found dead in its cage.

Autopsy.—Emaciated rabbit. Wt. 1640 gm. Body in opisthotonic position. The right pupil was larger than the left. The general examination was negative.

The dura and pia over the entire spinal cord showed overdistention of the blood vessels, but there was no excess of spinal fluid. There were a few dewdrop tubercles scattered along the lining of the thoracic vertebræ. No evidence of injury to the spinal cord was found.

There were numerous punctate hæmorrhages in the cerebral and spinal meninges and a few miliary gray tubercles were scattered along the meningeal arteries of the cerebral convexity. At the base of the brain a striking picture of basilar meningitis was seen. From a point anterior to the optic chiasm and extending over the pons and medulla the meningeal vessels were engorged, the meninges thickened, and numerous gray and yellow tubercles were seen in clusters along the vessels. There was also a slight excess of opalescent fluid. The ventricles were not dilated.

Examination of stained smears of the free fluid showed fibrin, a few mononuclear cells and scattered acid-fast bacilli.

The microscopic sections showed essentially the same findings as those noted in the protocol of Rabbit 329.

The guinea-pig inoculated with 4 cc. of the blood of this rabbit did not develop tuberculosis.

These experiments demonstrate that the injection of tubercle bacilli into the spinal canal of rabbits caused the development of meningitis. The clinical syndrome produced was definite, and the symptoms were typically those of meningeal inflammation. The signs most constantly noted were dullness and coma, or restlessness, excitability and hyperæsthesia to touch and light, anisocoria, paralyses, muscular hypertonicity, even opisthotonos.

The symptom-complex differed in animals that were given the same dose of bacilli, but it varied more constantly in direct proportion to the number and virulence of the infecting organisms.

The incubation period of the disease due to the bovine type of bacillus varied from 8 to 15 days; the latent period following infection with the human type was from 7 to 20 days.

The onset of symptoms was sudden, following a period of progressive emaciation. The duration of the disease due to the bovine type of bacillus varied from 9 to 14 days, as contrasted with a duration of 16 to 28 days of the infection due to the human type bacillus. In both types of infection the result was fatal.

After infection of the meninges with either variety of the organism, a generalized tuberculosis may develop. In a series of 12 experiments with bacilli of the bovine type, a general infection developed twice, and in a similar series with the human type it occurred once. These results confirm Manwaring's experience.

Worthy of note were the frequent occurrence of a basilar meningitis and the distribution of tubercles along the blood vessels. By what mechanism or along what route the bacilli reached the meninges of the base of the brain is a matter of speculation, for the injection of stains into the spinal canal showed that under the experimental conditions the material introduced was not mechanically made to enter the cranial cavity.

A possible explanation is that the bacilli caused a direct infection of the lymph spaces of the meninges and were disseminated along the cerebrospinal lymph vessels. On the other hand, the development of tubercles along the blood vessels and the production of endarteritis indicate a hematogenous spread of the organisms.

After it had been found that tuberculous meningitis could be produced in rabbits, and after the incubation period, the symptoms, course and outcome of the disease had been established, an attempt was made to modify the course and prognosis of the infection by treatment.

(a) The intraspinous injection of "albumose-free tuberculin."

During the latent period of meningeal tuberculous infection, from 1.0 to 20.0 mg. of albumose-free tuberculin were injected into the spinal canal at intervals of 2, 3 or 7 days.

In none of the six animals treated were any beneficial results noted. In fact, the reverse seemed true. The symptoms seemed to be aggravated and the infection was more rapidly fatal. At autopsy, too, a greater degree of meningeal congestion and more numerous meningeal petechiæ were found than in the untreated control animals.

(b) The intraspinous injection of "tuberculinized" serum.

The procedure of Swift and Ellis of injecting salvarsanized serum into the subdural space in the treatment of syphilis of the nervous system has given such promising results that a similar procedure was tested upon rabbits suffering from meningeal tuberculosis.

One and a half cubic centimeters of undiluted albumose-free tuberculin were injected into the ear-vein of a normal rabbit, and from 45 to 60 minutes later 5 cc. of blood were aspirated from the heart. The blood was allowed to coagulate, and after three hours the serum was removed by centrifugalization. Six rabbits, which had received an intra-meningeal injection of tubercle bacilli 20 hours before, were each given an intraspinous injection of 1.0 to 2.0 cc. of this serum. The treatment was repeated at intervals of 24 and 48 hours.

The results of this procedure were completely negative. The onset of the symptoms was not delayed, nor was the lethal outcome deferred or prevented.

(c) The intraspinous injection of the serum of tuberculous rabbits.

The auto-serum of rabbits suffering from tuberculous meningitis, and the serum of rabbits suffering from generalized tuberculosis, when injected into the spinal canal had no beneficial influence on the course of meningeal tuberculosis.

(d) The intraspinous injection of leucocytes from rabbits.

Fresh leucocytes of the rabbit were obtained and prepared according to the technic described by Opie.[2]

One-half cubic centimeter of turpentine was injected into the pleural cavity of a normal rabbit and a similar injection was made three days later. On the fourth day the exudate was removed by aspiration and discarded. The newly formed leucocytic effusion was then withdrawn into an equal volume of 1.5% solution of sodium citrate. It was then filtered through sterile gauze, centrifugalized, washed twice with 0.85% salt solution; and a 50% suspension of the washed cells in salt solution was prepared. The suspension consisted of polymorphonuclear and mononuclear cells with a variable number of red corpuscles. Before injection the sterility of the suspension was determined by culture.

From 1.0 to 1.5 cc. of such a suspension were injected into the spinal canal of rabbits that had been given an intraspinous injection of tubercle bacilli from 24 to 72 hours before.

One of the six animals so treated did not develop symptoms of meningitis until seven days later than the control animal, and lived for 40 days. The other five rabbits showed no benefit as a result of the treatment, and all showed essentially the same pathological findings as did the controls.

SUMMARY.

1. The introduction of tubercle bacilli into the spinal canal of rabbits leads to the development of meningitis.

2. Tuberculous meningitis in rabbits presents a fairly typical clinical picture and leads to a fatal issue.

3. The lethal outcome of the disease in rabbits was not prevented by the intraspinous injection of the albumose-free tuberculin, tuberculinized serum, the serum of tuberculous rabbits or a suspension of rabbit's leucocytes.

The ready production of meningitis in rabbits by the intraspinous injection of infectious material suggests the use of such a method to identify the nature of a meningeal infection in man. It would be a simple procedure to introduce into the spinal canal of a rabbit 1.0 to 2.0 cc. of the spinal fluid of a patient thought to have tuberculous meningitis, and in a few days examination of the rabbit's meninges might give evidence of the tuberculous nature of the patient's disease.

[2] E. Opie: Jour. Exp. Med., 1908, X, 419.

JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice; abstracts of papers read and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly. Volume XXVII is now in progress. The subscription price is $2.00 per year. (Foreign postage, 50 cents.) Price of cloth-bound volumes, $2.50 each.

A complete index to Vols. I-XVI of the Bulletin has been issued. Price 50 cents, bound in cloth.

A TREATMENT FOR PRURITUS ANI.

By Harvey B. Stone, M. D.

As is of course well recognized, pruritus ani is merely a symptom and not a disease. Without discussing exhaustively its etiology or pathology, it may be said that the cause of the distressing itching is often found associated with one or other of several varieties of local lesion—such as hemorrhoids, pinworms, eczema—or in some constitutional disturbance of which diabetes may be mentioned as an example. Obviously, where the cause is known, the principles of treatment will be determined by the particular nature of this cause, and it is not the purpose of this paper to discuss such cases. There remain, however, the numerous and most difficult cases in which no causative factor can be definitely discovered and which are grouped under the term "idiopathic pruritus."

Various theories—acid secretions, latent infection with special types of organisms, central and peripheral nerve disturbances—have been advanced to account for the condition. No less various treatments have been employed for its alleviation. The whole gamut of ointments, powders, lotions and irrigations have been employed with varying, but never general success. Cauterization, X-ray exposures, and vaccines have furnished more recent attempts to solve the problem. Operative measures, such as the Ball and Lynch procedures for division of the peripheral cutaneous nerves, have been employed. The fact that the latter have a certain field of usefulness and popularity is in itself evidence of the extent to which the patient is willing to go in seeking relief. One who has listened to the histories of such cases, with long months and years of intolerable annoyance and distress, broken rest, lost sleep, and impaired health, will feel that the attempt to improve our methods of attack upon this condition is not an unworthy field of endeavor. It is the purpose of this paper to make a preliminary report of such an attempt.

The success of alcohol injections for producing localized lasting anæsthesia, in facial and other forms of neuralgia, suggested the application of the same principle to the abolition of unpleasant sensations from the anal and perianal regions. The alcohol, of course, produces its effect by destruction of the nerve fibers with which it comes in contact. Hence, in essential principle, such a treatment is quite analogous to the Ball and Lynch operations referred to above, in which the cutaneous nerves are destroyed by direct mechanical division, instead of by chemical attack. The alcohol method presents certain definite advantages that will be referred to later; there are certain possible disadvantages, also, that will be considered at once. Since there is no selective action of alcohol, by which motor nerves are spared, and only sensory ones are injured, one might expect a loss of sphincter control, if the injection were allowed to come in close contact with the motor branches to the muscles. Moreover, an injection of a substance causing tissue destruction, if too superficially placed, might be expected to cause a slough and resultant ulceration.

In order to test these possibilities by actual experiments, alcohol injections were made into the anal region in dogs, the depth of the introduction being varied. Without detailing the protocols of experiments, the following facts were clearly proved. Alcohol injections will produce complete local anæsthesia. If introduced deeply enough to come in contact with the motor nerves, sphincter paralysis and resultant incontinence are produced. If introduced quite superficially—that is, within the skin itself—superficial sloughs are caused. It is quite possible, however, and not very difficult, to produce anæsthesia without sphincter paralysis or skin ulceration; this effect is brought about by introducing the needle entirely through the skin, but injecting the alcohol immediately under the skin and never more deeply.

The method has been tried by Dr. Arthur Hebb and myself in the dispensary of The Johns Hopkins Hospital and in our private practice on 17 cases so far, during a period covering less than two years. The facts observed are as follows. With the technique employed there is not much pain associated with the injection. There is some soreness during the first 24 hours, after which the only subjective sensation remarked is numbness. The itching is immediately abolished and the area injected is largely or completely anæsthetic. No case so far has shown the slightest evidence of disturbance in the action of the sphincter. There were several cases in which small superficial sloughs resulted, but these all healed promptly and without difficulty. They were due to faulty technique in placing the alcohol too superficially, a fault due to the careful avoidance of too deep an injection and to the fact that the folded, irregular surface of the skin about the anus renders it much more difficult to keep the injections at a uniform depth than would be the case were the surface level. How long the freedom from itching will last is not known. One patient has returned for a second injection, eight months after the first, for a recurrence of itching. All of the patients seemed much gratified with the results obtained, so far as we were able to follow them. An interesting change is to be noted in the physical appearance of the skin after a patient has received this treatment. The skin in typical cases of severe pruritus is thrown into thickened folds and ridges; it looks œdematous and grayish-white, with red scratch-marks and superficial fissures radiating from the anus, and feels stiff and indurated. A few days after an alcohol injection the folds become less pronounced and rugged; the color becomes more that of normal "flesh-color" and the scratch marks disappear. In short, there is a return to the normal appearance of the skin in this region.

The technique of injection is quite simple. The area in which the itching is complained of is carefully noted from the patient's description, and indeed is usually well marked out by the characteristic features just described. Under general or local anæsthesia, the injection is then made so that this whole

area is anæsthetized. In nearly all the cases here reported, a local anæsthetic, usually novocain (1 per cent) or quinine and urea hydrochloride (1 per cent), has been employed. This form of anæsthesia has proven quite satisfactory. The syringe is filled with alcohol (95 per cent) and the usual fine hypodermic needle used for the injection. The needle is carried entirely through the skin vertically and then is inclined sharply to the side so that it lies nearly parallel to the skin surface. When the needle is properly inserted in the subcutaneous fat, it can be moved fairly freely from side to side under the skin and can be felt moving with the finger placed over it. If this freedom of movement is lacking, the needle is probably engaged in the corium, and if injections are thus made, sloughs may be expected to result. With the needle properly placed the whole area involved is injected, enough alcohol being used to underlay the area thoroughly. The injection may be carried up to the margin of the anus, but we have never injected the anal canal itself, nor have we so far had reason to believe that this would have improved the results. Of course, before any injection is made, the skin is cleaned up as for any other operative procedure.

This method accomplishes practically the same thing as the operative treatment for pruritus, and is indicated in those cases of great intensity in which the usual measures have failed. It has certain distinct advantages over the operative procedures. It is safer—there is no undermined skin with impaired circulation, with a potential dead space under it, in an area impossible to keep clean. It is quicker. It entails no dressings, stitches, or other post-operative annoyance to physician or patient, and no hospital expense. It is quite as likely to be enduringly satisfactory, and presents no greater possibilities of trouble.

A REVIEW OF THE LIFE AND WORK OF JONATHAN LETTERMAN, M. D.[1]

By JOSEPH T. SMITH, M. D.

I esteem it a privilege, and it certainly is a pleasure, to be permitted to present to this club a brief review of the life and work of my uncle, Jonathan Letterman.

It seems especially fitting, in view of the war now waging, that we should have our attention directed to one who was able to accomplish so much in mitigating the horrors of war and whose methods are used to-day by the struggling nations of Europe.

Surgeon Clements, who was intimately associated with him as assistant medical director, says in his "Memoir of Jonathan Letterman, M. D." (p. 1): "It is the purpose of this memoir to perpetuate the name and to honor the memory of an officer, who effected an organization of the medical department of an army in the field, that not only contributed in a large degree to the discipline and efficiency of the foremost army of the Republic, but also robbed war of its horrors; who left behind him for the use of those to come the record of the means by which these noble ends may be again achieved; and who in rendering this great service to his country added a brilliant page to the record of the humane character of his profession."

Jonathan Letterman was born in Canonsburg, Pennsylvania, a small town near Pittsburgh, December 11, 1824.

His father, Jonathan Letterman, was an excellent physician and skilful surgeon. I remember hearing his mother, who was for many years an inmate of our house, tell of the sensation produced when her husband ligated an artery of the neck.

His mother was a daughter of Craig Ritchie, of Canonsburg, a man of character and influence; she was very fond of telling us of how, on more than one occasion, she saw her father walking with General Washington on the bank of Chartiers' Creek, a small stream near the town, discussing the financial condition of the young nation.

Dr. Letterman was well educated; a private tutor was provided for him until he was able to enter Jefferson College, Canonsburg, at that time one of the foremost in the country, which he did in 1842 and from which he graduated in 1845.

His medical education was obtained at the Jefferson College in Philadelphia and he received his degree there in 1849. In June of that year he passed the examination of the Army Medical Board and was appointed assistant surgeon.

He was ordered to Florida where he served in the campaigns against the Seminoles. While there he collected and preserved many specimens of the snakes, lizards, etc., in which the country abounded. This collection he sent to my father's house, together with beautiful articles of bead-work made by the Indians, all of which were a great delight to me.

In March, 1853, he was sent to Fort Ripley, Minn., and May, 1854, found him with the troops on their march from Fort Leavenworth, Kan., to New Mexico.

He was in service at Fort Defiance among the Navajos. I recall the curios he sent to our house, blankets and bead-work of the tribe.

He was engaged with Col. Loring in his expedition against the Apaches.

In 1859 he was on duty at Fort Monroe, Va., and the next year, 1860, he was ordered to California and was with Major Carleton in his expedition against the Utes.

In November, 1861, he came to New York with the California troops and went on duty with the army of the Potomac.

In May, 1862, he was appointed medical director of the department of West Virginia and in July was promoted to the rank of surgeon.

[1] Read before The Johns Hopkins Hospital Historical Club, January 10, 1916.

These 13 years' experiences were destined to be of great service to him in the trying months about to follow. The time, during most of those years, was spent at frontier posts and in campaigns against the Seminoles, Navajos, Apaches and Utes; many hardships had thus to be endured and resourcefulness was developed.

"In obedience to orders from the War Department," he reported on the first day of July, 1862, to Major-General McClellan at Haxhall's Landing for duty as medical director of the army of the Potomac and assumed his work on July 4.

Surgeon-General Hammond in making the appointment wrote to him (Clements, p. 3): "In making this assignment I have been governed by the best interests of the service. Your energy, determination, and faithful discharge of duty, in all the different situations in which you have been placed during your service of 13 years, determined me to place you in the most arduous, responsible and trying position you have yet occupied." .He closes: "And, now, trusting to your possession of those qualities without which I should never have assigned you to the duty, I commit to you the health, the comfort and the lives of thousands of our fellow soldiers who are fighting for the maintenance of their liberties."

That Dr. Letterman took this letter to heart and did possess the qualities necessary to accomplish the task it will now be our purpose to show.

Upon taking charge, the new director found the supplies almost exhausted; but few hospital tents were available, the ambulances were in a bad condition, the number of medical officers was too small for the service and it was not possible to obtain reports of the sick and wounded. The troops had been through the most trying experiences. Scurvy prevailed, a disease greatly dreaded because it so undermined the strength and depressed the spirits of the troops, thus reducing the efficiency of the soldiers. Owing to the conscientious and skilful labors of the medical director and his assistants, the conditions just noted were so far improved as to give time in which to consider the whole subject of the care of the sick and wounded; and Dr. Letterman at once addressed himself to the task.

The most urgent claim upon his attention was the care of the wounded. He says (Recollections, p. 22): "The subject of the ambulances became, after the health of the troops, a matter of importance. No system had anywhere been devised for their management. They were under the control both of medical officers and quartermasters, and, as a natural consequence, little care was exercised by either." Under his "order", issued August 2, 1862, the ambulances were taken from the immediate control of medical officers, so as not to interfere with their duties as surgeons, and placed under the care of special officers, but under such medical supervision as to make them efficient and available. Time will not permit of a further description of the plan; the "order" embraced 16 sections and was so carefully prepared as to all the details that but little modification was required when it was made "An Act of Congress" in 1864. That we may fully appreciate what the "order" and its accomplishment meant, let me quote from Lequoese, who in 1861 wrote (Clements, p. 5): "The removal of the wounded from the battlefield and their transportation to the hospitals is the most defective part of the medical service. Even now, after the great wars of the end of the last century and the beginning of the present . . . . this important service (in the French Army) is delegated to no particular person . . . . when the wounded fall in the ranks, there are none . . . . to carry them off except their own comrades." And the French Army at that time was the model army of the world.

The second of the great changes he brought about was in the method of supplying the army with medicines, dressings and medical material. Dr. Clements says (p. 9): "He (Dr. Letterman) reduced by careful selection the amounts of medicines and materials to be carried, lessened the number of wagons required to transport them to nearly one-half . . . . and gave simplicity, compactness and efficiency to the whole service of supply." Dr. Letterman says in his book (Recollections, p. 51): "Hitherto medical supplies for three months had been furnished, directly to regiments, and no wagons allowed expressly for their transportation . . . . not infrequently all the supplies of a regiment were thrown away by commanding officers, almost in sight of the enemy, that the wagons might be used for other purposes. The details of the new arrangement were published in a circular dated October 4, 1862, and no material change in its requirements was ever found necessary, the completeness of the plan having been at once demonstrated" (Clements, p. 9).

The third change inaugurated was a system of field hospitals, in the form of an "order" issued October 30, 1862, and it, like the others, was so complete in all its details that but few changes were required when it was put to a practical test. These hospitals were to care for the sick and wounded on or near the field of battle. None such, so far as is known, existed at that time in our armies. Their design was to relieve the immediate dangers of the wounded and in the case of those slightly disabled to put them speedily into a condition to return to the firing line.

An ambulance system, a supply system and a field hospital system were thus inaugurated: these three systems were but parts of a whole, designed to work together, so that out of their combined actions a complete scheme for the care of the sick and wounded might result.

He not only devised the means, but labored unremittingly to make them effective. That he was careful and painstaking is shown not only by the results obtained, but by the fact that so few changes were found necessary in their practical application.

In addition to working out the above problems Dr. Letterman gave close personal attention to the health of the troops, in combating scurvy, in looking after the sanitary conditions and healthful location and arrangements of the camps. He writes (Recollections, p. 46): "I established shortly after this battle (Antietam) two large camp hospitals. . . . . These were the first of the kind attempted in this country. . . . . For

the results of that battle gave additional evidence of the absolute necessity of a full and constantly renewed supply of fresh air to a wounded man." He experienced much difficulty in overcoming the prejudices against open camp treatment.

The lack of reports of the number and condition of the sick and wounded gave him great concern. He issued special blank forms for making such reports and in the "order" requiring them he says (Recollections, p. 115): "The knowledge which the officers of this department have had and may yet have opportunities of gathering, is of such a character and of such an extent as will, when made known, go far toward filling the hiatus which exists in our branch of the science in which we are now engaged—military surgery; and it is hoped that they will not permit these opportunities . . . . to pass without availing themselves of the advantages which they afford." He gave specific directions for the collection and preservation of specimens of gun-shot wounds for the Army Medical Museum.

He made an effort to have established in Washington a hospital for venereal diseases.

He labored with an intelligent endeavor to better the condition of the army; he had the men critically examined, if they complained of being sick; those with slight ailments were quickly cured and sent to their work, while those malingering were detected and held for duty; in this way the efficiency of the army was still further increased.

To protect the ambulances from being invaded by those who had no right in or about them, he established a system of passes.

He examined the requisitions, both medical and surgical, in order "to reduce the waste which took place when a three months' supply was issued to regiments, to have a small quantity given them at one time, and to have it replenished without difficulty." (Recollections, p. 51.) Upon one occasion he purchased a large amount of jellies, fruits and poultry for the use of the sick, thus carrying out his letter of instructions, to provide for the comfort of the troops.

It must be remembered that all these manifold changes, and more could be noted, were brought about while the army was engaged in warfare and that most actively.

As a result of his labors and those of his assistants, the army which in July, 1862, had a sick roll of (estimated) 20 per cent, had this reduced in the early part of 1864 to about 3 per cent. (Recollections, p. 183.)

It is not necessary to take up your time with an account of the care and management of the sick and wounded in the present war. The instructive and interesting letters, reports and correspondences from the front in the British Medical and other journals are more or less familiar, but one or two quotations from Dr. Letterman's "orders" might not be out of place as showing how closely his plans are followed; in fact they are almost the same, except in the more rapid removal of the wounded in automobiles and their better care in the well-equipped trains. In the 4th section relating to ambulances we read (Recollections, p. 25): "He will institute a drill in his corps, instructing his men in the most easy and expeditious method of putting men in and taking them out of the ambulances, taking men from the ground and placing them on stretchers." In his "order" relating to field hospitals he says (Recollections, p. 58): "Previous to an engagement there will be established in each corps an hospital surgeon for each division. He will detail another assistant surgeon whose duty it shall be to keep a complete record of every case . . . . the seat and character of the injury, the treatment, the operation, if any be performed, and the result, which will be transmitted to the medical director."

In October, 1863, he married Miss Mary Lee, of Virginia, a lady he met for the first time, when, tired and hungry from the battlefield of Antietam, he and some of his staff dined at her house, she waiting on the table. On the occasion of their marriage, the medical officers of the army of the Potomac presented him with a handsome service of silver.

In December, 1863, he requested that he be relieved from duty and wrote (Recollections, p. 184), "It is evident no military movements can be made by either army. . . . . The medical department has been fully organized in all its branches. . . . ." A memorial was presented to the Committee on Military Affairs of the United States Senate by the principal medical officers of the army urging "that he be honored with the rank and rewarded with the emoluments granted to the heads of other staff departments."

Upon retiring from the army of the Potomac, he was assigned to duty as inspector of hospitals in the department of the Susquehanna; here he remained until December, 1864.

Mr. Thomas A. Scott, the well-known president of the Pennsylvania Railroad, made him a very flattering offer to take the superintendency of a commercial company in southern California. His friends urged him to remain in the army, but he decided to resign. He left the army December 22, 1864, and entered the service of the company, but, as it failed to fulfil the hopes of its friends, he left it and took up his residence in San Francisco.

In 1866 he wrote a book, the title of which explains its purpose, "Medical Recollections of the Army of the Potomac."

He was elected coroner of San Francisco in 1867 and re-elected for a second term.

On December 4, 1871, he retired to private life. A chronic intestinal trouble from which he had long suffered combined with the shock occasioned by the death of his wife, November 1, 1867, so undermined his health that he was not able to withstand an illness in 1872 and he died March 15 of that year, being a few months over 47 years of age. He was buried in San Francisco by the side of his wife; a few years ago his elder daughter had the bodies removed to the National Cemetery at Arlington, so that he now rests from his labors in a grave which overlooks the Potomac, whose army he loved and served so well.

His simplicity, his modesty, his direct speaking and frank manner, his kindheartedness and consideration for others, combined with an unselfish nature and generosity in according praise when merited, made him hosts of devoted friends, and it was doubtless the possession of such qualities that enabled him to carry to a successful issue his plans for the good of the army in the field. Dr. Clements says that Dr. Letterman's

admiration of his corps of surgeons was great, and his confidence in them unbounded and "he omitted no opportunity to recognize and commend them."

That he had the good of the army at heart is shown by the following quotation from his "orders" (Recollections, p. 13): "Sleep during the day will not compensate for the loss of it at night, and I suggest . . . . that the men be allowed to sleep until sunrise and that they have their breakfast as soon as they rise."

In one of his "reports" he says (Recollections, p. 98): ". . . . the duties of medical officers are not confined to prescribing drugs, but it is also their duty, and one of the highest importance, to preserve the health of those who are well. . . . . The prevention of disease is the highest object of medical science," and again (Recollections, p. 122): "A corps of medical officers was not established solely for the purpose of attending the wounded and sick . . . . but the labors of medical officers cover a more extensive field. The leading idea, which should be constantly kept in view, is to strengthen the hands of the commanding general by keeping his army in the most vigorous health, thus rendering it in the highest degree efficient for enduring fatigue and privation, and for fighting." "I had," he says, "a twofold object in perfecting the physical condition of the troops. First, that the commanding general should have an army upon whose health he could rely. Second, that those who might be wounded should be in a condition to bear the shock and the operation, the suppuration, and the confinement, with every prospect of recovery." These quotations will, I think, suffice to show the underlying principles which guided him.

Last month in this room before the Medical Society, Dr. Richard P. Strong, of Boston, gave a very instructive and interesting account of his efforts in overcoming the typhus epidemic in Serbia in 1915. These two Americans, Drs. Letterman and Strong, the former in devising plans for the care of the sick and wounded, and the latter in teaching us how speedily to stamp out typhus fever, have rendered inestimable benefits to suffering humanity and to warring peoples.

Two surgeons, whose names are familiar to all in this audience, ought to be mentioned and some of their experiences noted before we close, as they give an insight into the conditions under which Dr. Letterman labored, and incidentally of his association with them. Dr. W. W. Keen in his "Addresses" (p. 421) says: ". . . . During the entire engagement (first battle of Bull Run) I never received a single order from either . . . . medical inspector, the surgeon of my regiment or anyone else. . . . . My experience in this battle is a good illustration of the utter disorganization or rather want of organization of our entire army at the beginning of the war. . . . . Not long after taking charge (of Eckington Hospital) on Saturday afternoon, about 4 o'clock, I received an order to report at the office of Dr. Letterman. . . . . I had so little experience in army orders that I almost trembled at the formal and peremptory character of the order." He says, again, (p. 430): "What we did not have in those days was almost more noticeable that what we did have. . . . . There were no hæmostatic forceps. . . . . We had no hypodermic syringes. . . . . We had no aspirators. . . . . We had no clinical thermometers." Dr. Garrison in his "Life of John S. Billings" cites the following passage (p. 20): "I (Dr. Billings) began service and had three things with me that none of the other surgeons had. A set of clinical thermometers like those Dr. Keen talked about, a straight one and one with a curve; a hypodermic syringe and a Symes staff. . . . . The hypodermic syringe was in constant requisition. The clinical thermometer was troublesome and was not used very much. . . . . One day in the spring of 1862 I was in the hospital office, when two men walked in, one a large man with an air of importance, the other a small man who had said very little. . . . . I then learned that my callers were Dr. Hammond, surgeon-general, and Dr. Letterman, medical director of the army of the Potomac." "On March 31, 1863, Dr. Billings reported for duty to Surgeon Jonathan Letterman . . . . who had achieved a brilliant reputation by his effective work in the reorganization of the medical department of that army . . . ." (Garrison, p. 30).

Within a quarter of a mile of San Francisco Bay . . . . located so as to receive the sea breezes through the Golden Gate, there stands a government hospital in which no department of the healing art fails to contribute its quota towards making the institution a veritable "general hospital." The buildings are modelled on the Paris Lariboisière, those for the sick being one story and arranged on the pavilion plan for 40 patients each, five surgical and four medical wards with a well-equipped operating room in a separate building. The hospital has the full modern equipment of laboratories, kitchens, baths, special detention and hydrotherapeutic wards. The hospital is an independent military station . . . . its laboratory is extensive and well equipped, and makes the bacteriological and chemical examinations for the military service of the entire Pacific Coast. Captain Weed has sent me a very interesting account of the hospital and he closes by writing: ". . . . By a general order of the War Department dated November 13, 1911, the hospital is hereafter to be designated the Letterman General Hospital in honor of the late Major Jonathan Letterman, surgeon, United States Army, who effected the organization of the medical department of the army of the Potomac during the Civil War.

The Letterman General Hospital is a fitting memorial to an officer who gave the best years and service of his life to caring for the sick and wounded, and nothing would rejoice him more than to have his name linked with such an institution.

DISCUSSION.

Dr. H. M. Hurd: We are under great obligations for this paper, and especially for those pleasant touches which brought Dr. Keen and Dr. Billings into contact with Dr. Letterman. I hope that everyone here who has not already done so will read the charming biography of Dr. Billings by Dr. Garrison. He was a young surgeon who happened to pass an unusually good examination before the Army Medical Board, which fact, if I remember correctly, was what attracted the attention of Dr. Letterman and induced the latter to visit the hospital of which Dr. Billings happened to be in charge on the Virginia side of the Potomac. He arrived unannounced in company with Surgeon-General Hammond, and it

finally appeared that he wished to see the man, as he expressed it, who had "downed" his favorite student in the examination. It seemed that Dr. Billings had received his order to appear for examination so late that when he presented himself there was doubt whether the examining board would consider him at all. The board was disposed to let matters go, as the marks had been made up and all were well satisfied with the results. When it was found that Billings was from Indiana, it was taken for granted that he would not succeed in passing the examination at all, and that his shrift would be a short one. The members of the board thereupon began to examine him, and to their surpise he did so well that they concluded he might get in at the end of the list. In order not to do any injustice to those already marked, they then concluded to give him the same examination which the rest had gone through. At the end of the following day, when he had answered all the questions satisfactorily, they concluded that he would rank so high that it might be necessary to examine him a third day to see how high his marks would be. When the examination was over, he was at the top of the list. This had attracted Letterman's attention. The rusticity of the methods of the army at that time is well shown by the fact that the surgeon-general of the army came with Dr. Letterman to see how the man who had passed such an examination was managing a hospital.

There is an interesting account, in Dr. Garrison's volume, of Dr. Billings' work as a surgeon at the battle of Gettysburg. He had little or no help there, and there were no special arrangements for hospitals. It was difficult indeed for him to provide the absolute necessities of life for 700 wounded patients. He describes that they were obliged to dig their own latrines and had no shovels. He was compelled to send out to neighboring farms for implements, and after half a day's search, finally got a shovel and I think also one axe. Yet during the few days which followed the battle, Dr. Billings was operating constantly. Indeed he seemed almost the only person who was doing such work in connection with 700 wounded. It is not at all surprising that he shortly afterwards broke down in health.

I shall be glad to have someone who has had a first-hand opportunity of seeing the present war in Europe tell us something about how the sick and wounded are taken care of there.

DR. T. B. FUTCHER: In reference to Dr. Smith's paper, it might be worth while to call the attention of those not familiar with them to the six volumes on the Medical and Surgical History of the War of the Rebellion. I think there are copies in the library here. They give a wonderful account of the war from a medical and surgical aspect, and anyone who looks over the illustrations will be greatly impressed with the care that was used in their preparation. Dr. Osler very frequently referred to the volumes on diseases of the intestinal tract, and in his clinic and at the bedside very frequently had those volumes brought for inspection. The plates on diseases of the intestinal tract, typhoid perforation and dysentery are as good as you will find in any work on diseases of the intestines published up to the present time. Many are reproductions of the excellent specimens in the Army Medical Museum in Washington.

PROCEEDINGS OF SOCIETIES.

THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

APRIL 3, 1916.

1. **The Treatment of Emergency Cases of Ectopic Pregnancy.** DR. E. H. RICHARDSON.

To appear later in the BULLETIN.

2. **Experimental Nerve Repair.** DR. DEAN LEWIS, Chicago, Ill.

To appear later in the BULLETIN.

APRIL 17, 1916.

1. **Some Recent Investigations on Ductless Glands.** (Abstract.) DR. W. B. CANNON, Boston, Mass.

During the past four or five years many of the researches of the Harvard Physiological Laboratory have been concerned with the bodily changes which accompany strong emotions, such as fear and rage. These are fundamental experiences in man and the lower animals, so much so that their expression constitutes a sort of common language. The studies which have been carried on have revealed interesting relations between these emotions and certain glands of internal secretion, and have suggested also a way in which emotional excitement may occasion pathological states.

When a cat becomes infuriated, the pupils are dilated and the hair is erect from the neck to the end of the tail. But besides these surface manifestations there are internal changes; for example, the heart beats rapidly and the activities of the stomach and intestines are stopped. Both the internal and the external changes are due to the passage of nerve impulses to viscera along the neurones of the sympathetic division of the autonomic system. The relation of the fibers connecting the central nervous system with these neurones is such as to provide for diffuse action on all the viscera that are innervated by this division.

The adrenal glands are supplied with nerves from the sympathetic division; and also the secretion of the adrenal medulla affects all structures innervated by the sympathetic division precisely as if they were being stimulated by its impulses. We have found that the adrenal glands secrete adrenin in times of great excitement, that there is an increased liberation of sugar from the liver so that glycosuria may result, that there is an abolition or prompt lessening of muscular fatigue, and that there is a very much more rapid clotting of blood. It is known also that adrenin causes a redistribution of blood in the body so that it is sent, away from the alimentary canal whose activities are inhibited, to the heart, the lungs, the central nervous system and active skeletal muscles. It is known, also, that adrenin causes dilation of the bronchioles and it is known that it increases the number of red blood corpuscles per cubic millimeter, an increase which Lamson has shown occurs also to a marked degree in cases of emotional excitement.

These changes, as true of man as of the lower animals in times of great emotional stress, are significant when the conditions which would give rise to the emotions are considered. Fear is associated with the instinct to flee; rage with the instinct to fight. These are the emotions and instincts underlying the struggle for existence. They are also the emotions and instincts into which all other instincts may be readily turned when they are thwarted. The internal changes are all directed towards increasing the efficacy of the organism for physical struggle. The increased blood sugar provides a source of muscular energy. The altered distribution of blood and the increased number of red blood corpuscles arrange for carrying an abundance of oxygen to active structures. The dilated bronchioles allow ready ventilation of the lungs when oxygen is greatly needed and carbon dioxide is being produced in large amounts. The provision for lessening muscular fatigue is directly useful in muscles likely to be employed in continued action. The rapid coagulation of blood tends to preserve that precious fluid in cases of injury to blood vessels. The organism in which these changes most promptly occur has the greatest re-inforcement of its abilities and is most

likely to be favored in physical struggle. These arrangements for re-inforcement account for the great power and endurance which are exhibited in times of intense excitement.

Other glands than the adrenal are not so readily studied because of the difficulty of recognizing their secretions. It has long been known, however, that physiological activity is accompanied by the presence of an electrical difference which may be observed by connecting an active part with an inactive part of the body through a sensitive galvanometer. Justification of this method of studying glands can be obtained by applying it to the submaxillary gland. It has been found that the electrical change begins before the external secretion appears, disappears as secretion stops, and is not related either to flow of fluid in the ducts or a change of blood flow in the capillaries. Since the only feature that cannot be abolished without abolishing the electrical change is secretion, the electrical effect is a true indicator of a secretory process. When this method, therefore, is applied to the thyroid gland, the positive testimony of the galvanometer is evidence of thyroid secretion.

The electrical method shows that the thyroid gland is subject to impulses from a part of the sympathetic division of the autonomic system, *i. e.*, the cervical sympathetic. The secretion comes promptly—after a latent period of from 5 to 7 seconds. The vagus nerve is without control, and pilocarpine, as a stimulator of vagus endings, is likewise without control. The influence of the sympathetic is not due to anemia, for shutting off the blood supply has no such effect as is produced by sympathetic stimulation.

Control by the sympathetic implies that adrenin may be effective in stimulating the thyroid. This, in fact, is the case, for a marked electrical change is produced when adrenalin (0.1 cc. of 1:100,000) is injected intravenously into a cat. Furthermore, the action current of the thyroid appears if the nerves to the adrenal gland are stimulated, an effect which does not occur if the adrenal glands have been previously removed, and which is delayed if the return of blood from the abdominal cavity is delayed, until the blood is again allowed to flow.

Thus a hormone relation between the adrenal and the thyroid is clearly demonstrated. This electrical evidence, which was obtained in co-operation with Mr. McKeen Cattell, has been confirmed by the observations of Dr. Robert L. Levy. He has found that both stimulation of the cervical sympathetic trunk and injection of stimulating doses of adrenalin greatly augment the effects of small doses of adrenalin in raising blood pressure. This increase of efficacy of adrenalin is not produced if the thyroid glands have previously been removed.

The proof that the thyroid responds rapidly to sympathetic stimulation, and that it is effective in combination with adrenal secretion, shows that there is another bodily change to be added to those already mentioned as occurring in times of great emotional excitement.

In the course of this work two questions have arisen. First, why are organs which are disturbed in times of emotional stress not disturbed at other times? It seemed probably that they were protected from interference by a high neurone threshold interposed between the central nervous system and the visceral cells. Consequently, only when great excitation is present in the central nervous system is this threshold crossed and the changes in the viscera brought to pass. The second question is, why, in certain pathological cases, is there apparently frequent or continuous disturbance of these same viscera? It seemed possible that this might be due to a wearing down of the high threshold here or there from frequent or great emotional experiences. Thus the situation would be like a break in a dike, and only a slight disturbance in the central nervous system might then be needed to result in a pouring through of impulses at the low point and consequently a fairly frequent or continuous disturbance in the viscus innervated by this region. Thus dyspepsia, tachycardia and probably persistent glycosuria, reported as having an emotional origin, might be accounted for.

To test the effect of continuous stimulation the phrenic nerve was fused with a peripheral portion of the cut cervical sympathetic. This operation, done with the aid of Dr. C. A. L. Binger, resulted in some animals in tachycardia, increased excitability, loose movements of the bowels, exophthalmos on the operated side (in one case) and, as Dr. Reginald Fitz showed, in great increase of metabolism (in one case an increase of 130 per cent). These phenomena have disappeared on removal of the thyroid gland on the operated side. The adrenal glands in two animals that have died of the disease have been greatly enlarged.

The changes thus produced resemble in many respects the symptoms of exophthalmic goitre and support the view that this disease may be primarily due to overactivity of that part of the nervous system disturbed in emotional excitement, possibly, as suggested above, caused by a local stimulation in the cervical region. Two vicious circles may be operative: one through the nervous system due to increased excitability from increased thyroid secretion and resulting thus in increased nervous stimulation of the gland; the other through the blood stream due to increased adrenal activity from overaction of the thyroid and stimulating the thyroid in turn in the manner indicated above.

The evidence previously presented shows that, besides any routine function, the adrenal gland has an emergency function brought out in times of great excitement. It is not unreasonable to suppose that the thyroid gland likewise has an emergency function evoked in critical times, which would serve to increase the speed of metabolism when the rapidity of bodily processes might be of the utmost importance, and, besides that, augmenting the efficiency of the adrenin which would be secreted simultaneously.

2. **The Latent Period in the Growth of Bacteria.** Dr. A. M. Chesney, New York City.

THE JOHNS HOPKINS HOSPITAL HISTORICAL CLUB.

APRIL 6, 1916.

1. **History and Discovery of the Secretory Glands.** Dr. Mortimer Frank, Chicago, Ill.

To appear later in the Bulletin.

NOTES ON NEW BOOKS.

Hospitals and the Law. By Edward Valentine Mitchell, LL. B., College of Law, University of South Dakota, author of "The Doctor in Court." (*New York: Rebman and Company, 1915.*)

This valuable little book deserves to be in the library of every hospital. It is not a formal treatise on law for the guidance of the trained lawyer, but rather a manual for the hospital administrator, to give him needed instruction upon the rights, privileges and responsibilities of the hospital. From it he will learn that every hospital must be conducted with reasonable skill and diligence under competent medical advice and assistance; that the rights of a charity hospital, established for the public welfare and the relief of suffering differ widely from those of a private sanitarium, established for gain by private parties; that the former, being supported by gifts and endowments for charitable purposes, cannot divert these funds to the payment of damages as long as its governing board exercises proper care in the selection of physicians or nurses; that hospital authorities in the exercise of such care cannot be held responsible for accidents or misadven-

tures, even if their employees have failed to show unusual discretion or skill in the discharge of their duties: it is sufficient if they have acted wisely and to the best of their judgment. The status of the charitable hospital which receives private patients, who pay for their care and treatment, is also the same. The private patient is in a quasi-charitable relation, because he avails himself of the facilities afforded by an institution established as a charity, and the payments which he makes are received to maintain and extend the charitable work of the hospital. The same principle also applies in suits for damages because of careless or wrongful acts of employees, provided that the hospital authorities exercised due care in selecting, procuring and engaging them. This principle has been established as necessary to guard charitable funds from the schemes of blackmailers, adventurers and malingerers.

The book also treats of the relations of officials and employees; of the need of adequate records made contemporaneously with the event by physicians and nurses; of the consent of patients prior to an operation; of the consent of friends to an autopsy in non-legal cases.

We are gratified to see a reference to a decision of the court in a Western state, in which it was held that the good faith of a physician in refusing to discharge an unrecovered mental patient because of the latter's irresponsibility was an ample justification for his course, even when the patient had been imperfectly committed.

As has been previously said, the book is worthy of the attention of all hospital officials.

Essentials of Physiology. By F. A. BAINBRIDGE and J. A. MENZIES. Price, $3.00 net. (*London: Longmans, Green and Company, 1914.*)

The object of this book, to meet "the requirements of the medical student preparing for a *pass* examination . . . .," in the opinion of the reviewer has been very well accomplished. The italics in the quotation are the reviewer's, as he wishes to point out that the book should not be relied on alone by students while *studying* the subject of physiology. There is a complete lack of adequate reference to original sources, and the matter is necessarily presented in too dogmatic fashion to give the student the proper perspective for any effective thinking or successful application of the knowledge imparted.

In brief, to use a term employed in this country, the book is a high-grade "Quiz Compend" without any questions asked.

C. D. S.

Laboratory Methods. By WILLIAMS and WILLIAMS. Third Edition. Price, $2.50. (*St. Louis: C. V. Mosby and Company, Publishers, 1915.*)

According to the author's prefatory note, this book is "especially designed for the general practitioner who desires to make, easily and inexpensively, examinations on which he may depend." The authors have devised a simplification of methods, both as to apparatus and technique, and claim to have given only the best tests, so that the reader will not be perplexed by being obliged to do any choosing. According to an introductory note by Victor C. Vaughan, "this little volume shows how the general practitioner can, at a very small cost, equip a laboratory in which he can do most excellent work." Such a statement is probably a true one, and the idea of encouraging more careful studies of patients is highly to be commended, but in the opinion of the reviewer, the methods he suggests are apt, in the long run, to do much more harm than good. So many inaccuracies could be pointed out, so many misleading short-cuts have been suggested, that it is somewhat difficult to pick out one more glaring than another.

The book is divided into 17 chapters, a number of which bear rather unusual titles, such as "Vascular Dramas," "Diazo versus Widal," "To Find the Treponema in Six Minutes," and so on. Each chapter is introduced with a summary of the apparatus which will be needed for that particular type of work, and this apparatus is pictured on the opposite page. At the end of the book a chapter entitled "Indications for Laboratory Aids" is given, so that it only becomes necessary to turn to it, look up any given disease and promptly find what can be done in the laboratory to clinch the diagnosis. A number of rather interesting suggestions are made in this chapter, such as the searching "of muscle bits for encapsulated larvæ" of Ascaris lumbricoides; and that in all cases of diabetes mellitus a search of the stools should be made for intestinal parasites. Under pernicious anæmia one is advised to endeavor "to discover the cause, for which examinations of the urine and fæces should be made." On the other hand one finds quite an extensive list of conditions, such as small-pox, measles, yellow fever, sun-stroke, arthritis deformans, epistaxis, diseases of the thyroid, etc., which appear only as titles with no suggestions at all as to how the laboratory can be of use. The puzzled practitioner is set straight in Chapter IX as to the diagnostic value of the diazo reaction, compared with the Widal test, in typhoid fever, but no suggestions are made for blood cultures in this condition. Under the heading "Every Day Stool Tests" it is stated that there is no need for making comparisons of the common ova "when the symptomatology, geographic distribution and other factors are considered." This statement is, of course, a helpful one to anyone endeavoring to rule out helminthiasis.

These few examples, of which hundreds of others could be cited, are enough to indicate in a general way, the scope of this book. It seems a pity that, whereas the authors themselves realize that no book of this size can include all that is good in the medical laboratory, they should perpetrate upon the medical profession a work which tends to encourage the misinterpretation of everyday facts and leaves one utterly stranded when it comes to running down anything unusual.

S. R. M.

Twilight Sleep. By ALFRED M. HELLIMAN, M. D. Price, $1.50. (*New York: Paul B. Hoeber Company, 1915.*)

The first half of the book presents a good review of the literature and deals nicely with the controversial side. In the sixth chapter the pros and cons of American opinion on the subject are taken up and from there on is an exposé, especially of the application of the Gauss method. The employment of agents other than scopolamine-narcophine is gone over in the ninth chapter, while the tenth proffers a review, with concluding remarks defining the value of the procedure. An addendum displays specimen charts and the last pages are devoted to a complete bibliography to June, 1915.

W. L. M.

The Adolescent Period: Its Features and Management. By LOUIS STARR, M. D., LL. D., Fellow of the College of Physicians of Philadelphia; Fellow of the Royal Society of Medicine, London, etc. (*Philadelphia: P. Blakiston's Son and Company, 1915.*)

This little book of about 200 pages is a continuation of a former work, "Hygiene of the Nursery," and its purpose is to present an outline of the physical and psychical changes which are developed between the end of childhood and the close of adolescence.

It presents an excellent introductory chapter on the growth and development of muscle power. It treats of automatisms and explains their connection often with an asymmetrical development of the muscles and their relations to excessive physical inactivity and mental concentration. The remedies for them the author be-

lieves to lie in diversified industrial education, manual training and gymnastics, and plays, games and sports.

The next chapter speaks of athletic training for boys, in which he urges the necessity of a careful preliminary examination as to the competency of the heart, lungs and kidney function to undergo such training. He does not approve of strict athletic training for all boys, because of the bodily hardships and restrictions of diet, which may be injurious to some. All meals should be substantial and not hurried, and plenty of time for sleep is all-essential. The training advocated for girls is less definite, and one gets the impression that athletics are less feasible for them.

The chapter on the disorders of adolescence is one of the most interesting and helpful in the book. It takes a wide range, and in addition to the ordinary bodily diseases more common at this period deals with spinal curvature, abnormalities of speech, sleep anomalies, nervous disturbances such as hysteria, and mental disturbances such as over-conscientiousness, anxiety neuroses, depression, melancholia, neurasthenia and disturbed mentality. The remarks upon the connection of sexual development with these states are very judicious.

The chapter on the faults of adolescence opens the interesting topics of delinquency, truancy, lying, theft, incendiarism, intemperance, prostitution, suicide, etc. In reading it one gets an impression that many of these faults are not so much the outgrowth of the natural development of adolescence as the result of feeble-mindedness or inherent mental defect. Some of them at least do not seem to belong here.

The remaining chapters relate to menstruation and sexual enlightenment. The latter seems to be a fairly successful handling of a very difficult subject. The book is to be commended to thoughtful parents.

Urgent Surgery. By Felix Lejars. Translated From the Seventh French Edition by William S. Dickie, F. R. C. S., and Ernest Ward, M. A., M. D., F. R. C. S. Vol. II. The Genito-Urinary Organs—The Rectum and Anus—The Strangulated Hernias—The Extremities. Price, $7.00. (*New York: William Wood and Company, 1915.*)

This second volume of Lejars' well-known work contains nearly 600 pages of text, is profusely illustrated, and well indexed. The translation preserves admirably the lucidity of style of the original done into excellent English. The typographical arrangement, by which subjects, paragraph headings and important words and sentences are emphasized, renders the locating of any desired reference quick and general reading easy.

The subject matter is indicated in general by the sub-title of this particular volume. The various lesions are briefly but clearly described, their etiology is mentioned and a very clear but succinct description of the treatment presented, which is made all the more easy to grasp by the numerous good illustrations. To the captious, there might be some question as to the choice of lesions considered as deserving discussion in a work devoted to urgent surgery. Thus, in the section devoted to the genito-urinary organs, although some ovarian conditions are included, no mention is made of cysts with twisted pedicles, nor is extra-uterine pregnancy taken up; whereas, on the other hand, lacerations of the perineum incident to labor are considered in some detail—a condition no doubt requiring attention, but certainly, in comparison with the other two lesions just mentioned, not to be regarded as urgent. The section devoted to the rectum and anus is very well presented, the methods described are admirable, and the choice of subjects for inclusion is not open to criticism. The portion of the book dealing with strangulated hernia is really a very complete monograph of over 100 pages, including a consideration of even the rare forms of this most important surgical emergency. The last part of the book is concerned with the urgent surgery of the extremities and naturally is largely taken up with a discussion of wounds, fractures and dislocations. Here again the characteristics of clearness, brevity, and good judgment, both in choice of subject-matter and in methods of therapy, are predominant. One is perhaps a little surprised to find the question of bone-plating, that has been so much discussed of recent years, especially in English and American literature, dismissed with scarcely more than bare mention. The author evidently makes much greater use of the older methods of suture and ligature for the fixation of fragments in open operations on the bones.

W. E. D.

BOOKS RECEIVED.

Who is Insane? By Stephen Smith, A. M., M. D., LL. D. 1916. 12°. 285 pages. The Macmillan Company, New York.

An Autobiography. By Edward Livingston Trudeau, M. D. Illustrated. 1916. 8°. 322 pages. Lea & Febiger, Philadelphia and New York.

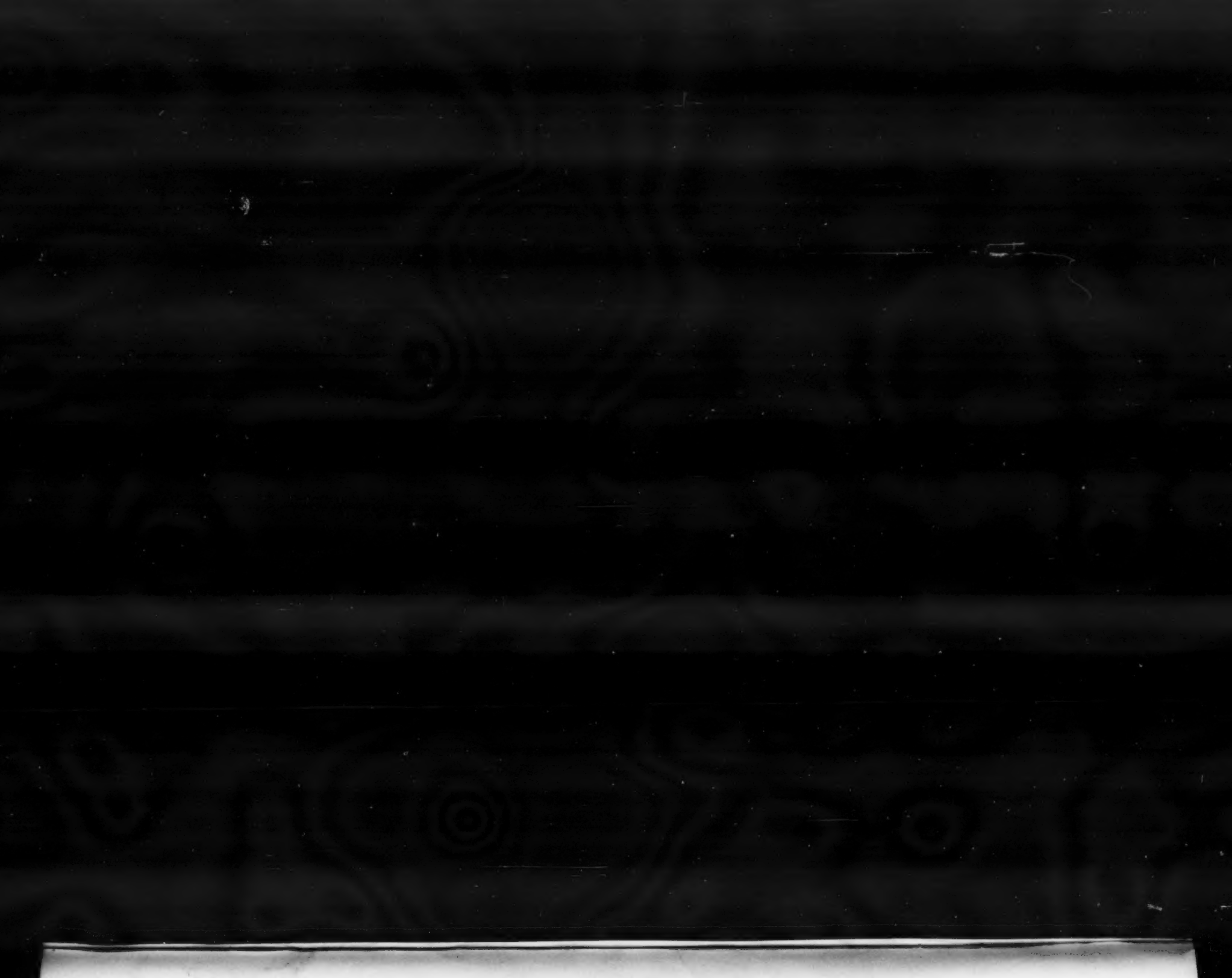
Transactions of the Clinical Society of the University of Michigan. October, 1914-October, 1915. Volume 6. Edited by the Secretary-Treasurer. 1915. 8°. 133 pages. Ann Arbor, Michigan.

A Reference Handbook of the Medical Sciences. Embracing the Entire Range of Scientific and Practical Medicine and Allied Science. By various writers. First and second editions edited by Albert H. Buck, M. D. Third edition, completely revised and rewritten. Edited by Thomas Lathrop Stedman, A. M., M. D. Complete in eight volumes. Vol. vi. Illustrated by numerous chromolithographs and four hundred and ninety half-tone and wood engravings. 1916. 4°. 967 pages. William Wood and Company, New York.

The Treatment of Acute Infectious Diseases. By Frank Sherman Meara, M. D., Ph. D. 1916. 8°. 540 pages. The Macmillan Company, New York.

The Primary Lung Focus of Tuberculosis in Children. By Anthon Ghon. English edition. Authorized translation by D. Barty King, M. A., M. D. (Edin.), M. R. C. P. (Lond. and Edin.). With seventy-two text illustrations, one black and one colored plate. 1916. 8°. 172 pages. J. & A. Churchill, London.

A Practical Treatise on Infant Feeding and Allied Topics. By Harry Lowenburg, A. M., M. D. Illustrated with 64 text engravings and 30 original full-page plates, 11 of which are in colors. 1916. 8°. 382 pages. F. A. Davis Company, Philadelphia.

Deutsche Frauenheilkunde. Geburtshilfe, Gynäkologie und Nachbargebiete in Einzeldarstellungen. Herausgegeben von E. Opitz. Zweiter Band, *Der abdominale Kaiserschnitt.* von Professor Dr. Otto Küstner. Mit 10 Abbildungen. 1915. 8°. 186 Seiten. J. F. Bergmann, Wiesbaden.

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